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PRELIMINARY INSTRUCTION MANUAL
FOR
SWEEP OSCILLATOR
MODEL 6615ED, SPEC. 2055

Manual No. 1-500783-310

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PRELIMINARY INSTRUCTION MANUAL
FOR
SWEEP OSCILLATOR
MODEL 6615ED, SPEC. 2055

Manual No. 1-500783-310

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7. Other comments.

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken and any other relevant data.

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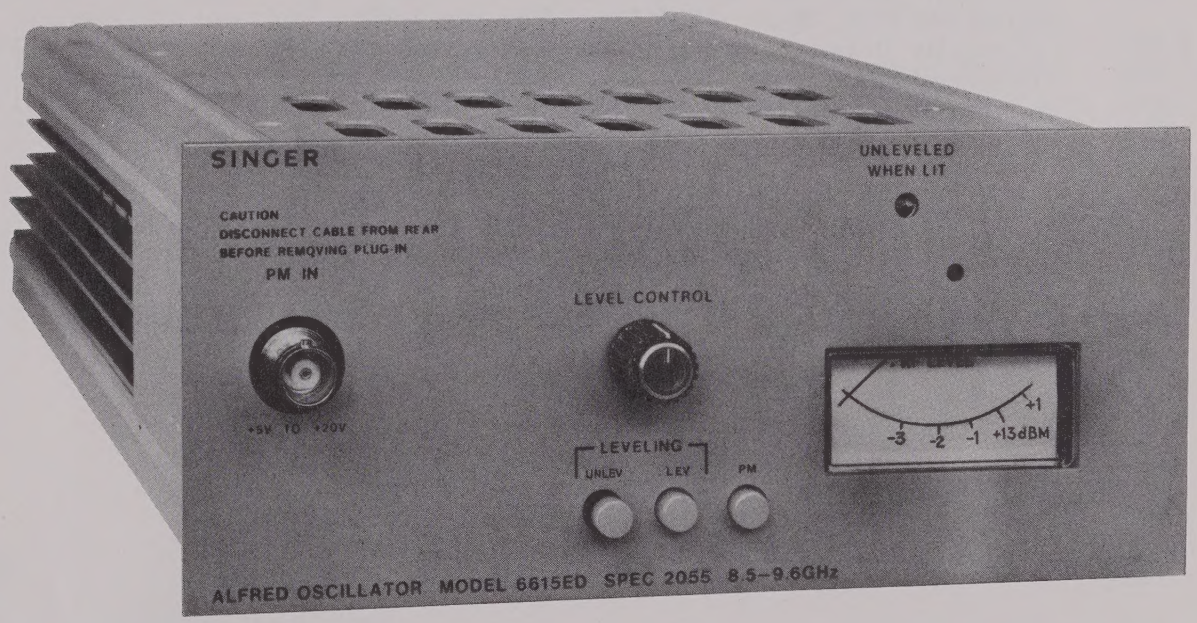


Figure 1-1. Oscillator, Model 6615ED, Spec. 2055

Section 1

INTRODUCTION

1.1 SCOPE OF MANUAL

This manual provides operational information for the Model 6615ED, Specification 2055, Sweep Oscillator. The Manual is divided into seven sections containing a general description of the equipment and accessories; specifications; controls, indicators and receptacles; installation; operating instructions; parts list; and schematic diagrams.

1.2 PURPOSE AND GENERAL DESCRIPTION

The Model 6615ED Plug-in unit, plugs into a Model 6600, Spec. 2053 Mainframe to form an RF sweep oscillator. Hereafter in the manual the descriptions assume that the Model 6615ED Plug-in unit is installed in the Model 6600 Spec. 2053 Mainframe.

The frequency range of the Model 6615ED can be electronically swept-tuned or manually tuned over the 8.50 to 9.60 GHz frequency range. The RF output can be leveled internally or externally as selected by front panel control. Internal 1000Hz square wave modulation is provided. Input for external AM or square wave modulation and external FM modulation are included.

Special provisions include an external input for fast rise and fall pulse modulation and for calibrated power level setting.

1.3 SUPPLIED ACCESSORIES

The items listed in Table 1-1 are furnished with the Model 6615ED Sweep Oscillator.

Table 1-1. Supplied Accessories

Quanitity	Item	Singer Part No.
1	Frequency Dial Face Plate	942-405-32
1	Instruction Manual	1-900783-310

Section II

SPECIFICATIONS

2.1 GENERAL INFORMATION

This section contains specification information for the Model 6615ED, Spec. 2055 Plug-in sweep oscillator. The Plug-in operates within its specifications only when used with a Model 6600, Spec. 2053 Mainframe. The special Model 6600 Mainframe affects the F_o fine scale accuracy and provides a fixed, F_o marker in the ΔF sweep mode in addition to the M_1 and M_2 markers.

NOTE

If a standard Model 6600 Mainframe is used, the F_o fine scale readings have to be multiplied by 5/8 to obtain an accurate F_o fine indication.

2.2 SPECIFICATIONS

The following specifications cover the combined performance of the Model 6615ED, Spec. 2055 Plug-in and the Model 6600, Spec. 2053 Mainframe.

2.2.1 FREQUENCY CHARACTERISTICS

2.2.1.1 Frequency Range: 8.50 GHz - 9.60 GHz

2.2.1.2 Swept Frequency Operations:

a. Full Band Sweep: 8.5 GHz - 9.6 GHz

b. $M_1 \rightarrow M_2$ Sweep: Sweeps from M_1 to M_2 up or down in frequency: continuously adjustable to any combination of start and stop frequencies between 8.5 GHz and 9.6 GHz.

c. △F Symmetrical Sweep: Sweeps symmetrically upward in frequency about F_o. Sweep width is continuously adjustable from 0 to 0.15 GHz.

d. The dial markings on the △F sweep scale are: Markings at 0, 0.05, 0.10, 0.15 GHz; minor divisions every 10 MHz between markings.

e. Accuracy of △F Width: ±(2% of △F Reading +2.1 MHz).

f. Manual Sweep: Manually sweeps between sweep limits of Full band, Marker or △F sweep modes.

g. Sweep Light: Indicator lights during sweep.

h. Sweep Triggering Modes:

Internal: Internally-triggered recurring sweep.

Line: Recurring sweep synchronized with line frequency.

External: External trigger of +1 volt for 2 microseconds minimum activates sweep (rear panel).

i. Sweep Voltage:

DC-coupled sawtooth varying from 0 volts at start to +10 volts at end of sweep, regardless of sweep mode, width, or direction.

In CW mode, voltage varies from 0 to +10 volts in proportion to F_o frequency setting.

j. Retrace RF Blanking: Output power attenuated. Selected by depressing "BLANKING". RF is turned on prior to start of sweep to allow stabilization of external equipment.

k. Blanking Pulse: Two rear panel connectors provide +10 and -10 volts during retrace. Z= 10 K.

l. Pen lift: Relay contact open or closed during retrace (rear panel).

m. External Sweep: Zero to 10 V applied to "J1" (rear panel of 6600 mainframe) sweeps frequency across full range at DC - 100 Hz rate.

2.2.1.3 Single Frequency Operation:

a. CW Operation: Single frequency selected is indicated by the F_o pointer on the main scale of the frequency dial.

b. CW Frequency Range: 8.50 GHz - 9.60 GHz.

c. Frequency scale markings for CW operation are:

Markings every 100 MHz starting with "8.5" and ending with "9.6", with major divisions every 50 MHz between each 100 MHz marking, and minor divisions every 10 MHz in between.

NOTE

The same scale is used for setting M_1 and M_2 pointers for $M_1 \longrightarrow M_2$ sweep or for marker operation.

d. CW Frequency Accuracy (at 25° C): ± 20 MHz.

e. CW Fine Operation:

One single frequency selected, offset from the F_o frequency as indicated by the F_o fine pointer. Offset is continuously adjustable from 0 to + or - 0.085 GHz.

The scale markings of the F_o fine scale are: Markings every + and -0.01 GHz, up to and including "08". Minor divisions at every 5 MHz in between.

Accuracy of F_o fine scale: ± 1.7 MHz.

2.2.1.4 Frequency Stabilities:

F_o stability (with sweeper either in CW, CW fine or ΔF sweep mode):

with temperature:	±0.03%/°C.
with time (after 1 hr. warm-up):	±0.015%/15 min.
with line voltage:	± 100 kHz/±10% line voltage change.
with power level change:	± 1 MHz/5 dB.

2.2.2 Spectral Purity Characteristics

2.2.2.1 Harmonics: Each harmonic $\geq$ 20 dB below the carrier level for RF output level range as indicated on level meter.

2.2.2.2 Spurious Outputs: Each spurious output $\geq$ 40 dB below the carrier level for RF output level range as indicated on level meter.

2.2.2.3 Residual AM: The rms value of residual amplitude modulation in a post-detection bandwidth of 10 Hz - 10 kHz is $\geq$ 40 dB below the carrier for RF output level range as indicated on level meter.

2.2.2.4 Residual FM ("F_o", "F_o Fine" mode):

$\geq$ 15 kHz peak (post-detection bandwidth 1Hz to 10 kHz).

2.2.3 RF Power Output Characteristics:

a. Output Power Control Range (at 25° C):

Continuously adjustable from at least + 14 dBm to + 4 dBm into a 50Ω load (in leveled operation) over 8.5 - 9.6 GHz frequency range.

b. Power Output Indicator:

Level meter calibrated in dB from -3 dB to +1 dB, with markings at -3, -2, -1, 0, and +1 with 0 representing + 13 dBm into a 50Ω load.

c. Output Level Accuracy:

With level meter set to "13dBm", the RF output power into a 50Ω load is + 13 dBm ±0.5 dB at 9.0 GHz at 25° C.

Output Level Flatness:

±0.5 dB over entire frequency range, referenced to 9.0 GHz.

d. Power Output Stability:

with temperature: ± 0.2 dB/10°C.

with line voltage: ± 0.1 dB/±10% line voltage change.

e. Output Connector:

Rear panel mounted, type N, female.

2.2.4 Amplitude Modulation Characteristics:

2.2.4.1 Internal Square Wave AM:

Internal Square Wave AM is selected by depressing "AM" button on the Model 6600 Mainframe, and setting the rear panel switch

to INT. SQ. WAVE" position.

a. Modulation Frequency: 1 kHz nominal (can be adjusted continuously between 950 Hz and 1050 Hz using a rear panel mounted control on 6600 mainframe).

b. Power Output: Power output during "on" period the same as unmodulated power output (at same "Level Adj." setting) within ±0.2 dB.

c. On/Off Ratio: $\geq$ 40 dB at + 13 dBm. Decreases with decreasing power level using "Level Adj.": $\geq$ 30 dB at + 3 dBm.

d. Power Meter Indication During Internal Square Wave Modulation: Meter deflection decreases to about 50% of the deflection for unmodulated output (averaging period approx. 0.1 sec).

e. Rise and Fall Times: $<$ 10 sec.

2.2.4.2 External Square Wave AM:

External Square Wave AM is selected by setting the rear panel switch to "external square wave" position, feeding a square wave of 5 V (±10%) peak amplitude (or a sine wave of at least 7 V peak amplitude) into the "EXT. AM" input on rear panel of the Model 6600 Mainframe, and depressing the "AM" button. Audio generator output resistance is $\geq$ 50 Ω.

a. Modulation Frequency Range: 100 Hz - 10 kHz

b. Power Output: See "Internal Square Wave AM" specification

c. On/Off Ratio: See "Internal Square Wave AM" specification

d. Power Meter Indication During External Square Wave Modulation: For square wave with equal on and off periods, power meter reading is approximately 50% lower than for unmodulated output.

e. Modulation Sensitivity: 0 V: RF off,
+5 V: RF on.

2.2.4.3 Pulse Modulation:

Pulse Modulation is selected by depressing the "PM" button on the Model 6615ED, Spec 2055 plug-in, and feeding a pulse signal into the "PM IN" BNC connector on the Model 6615ED front panel. In the pulse modulation mode, the level meter displays the peak power level. The peak power level is adjustable over the same level range as the CW level (at least +14 dBm to +4 dBm).

a. Pulse Repetition Frequency Range: 500 Hz - 10 kHz.

b. Pulse Width Range *: 0.2 μsec - μ10 sec.

c. Rise and Fall Times*: < 50 nsec.

d. On/Off Ratio: ≥ 60 dB, typically 70 dB.

e. Overshoot*: ≤ 10% peak of linear amplitude (excluding video feedthrough).

f. Droop*: ≤ 2% of linear peak amplitude.

g. Video feedthrough*: 0.6 V peak max. into 50 Ω.

* Refer to Figures 2-1 and 2-2.

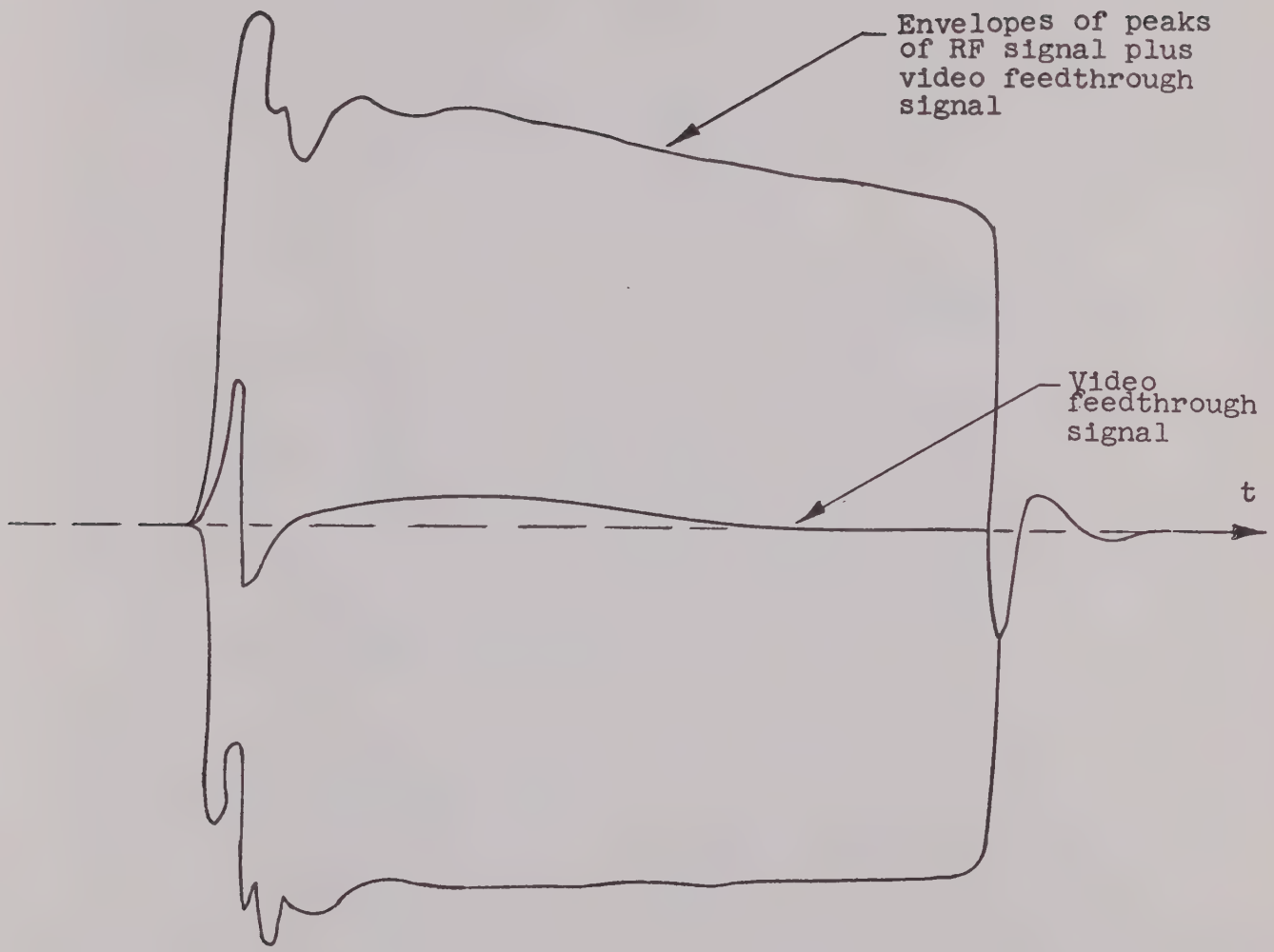
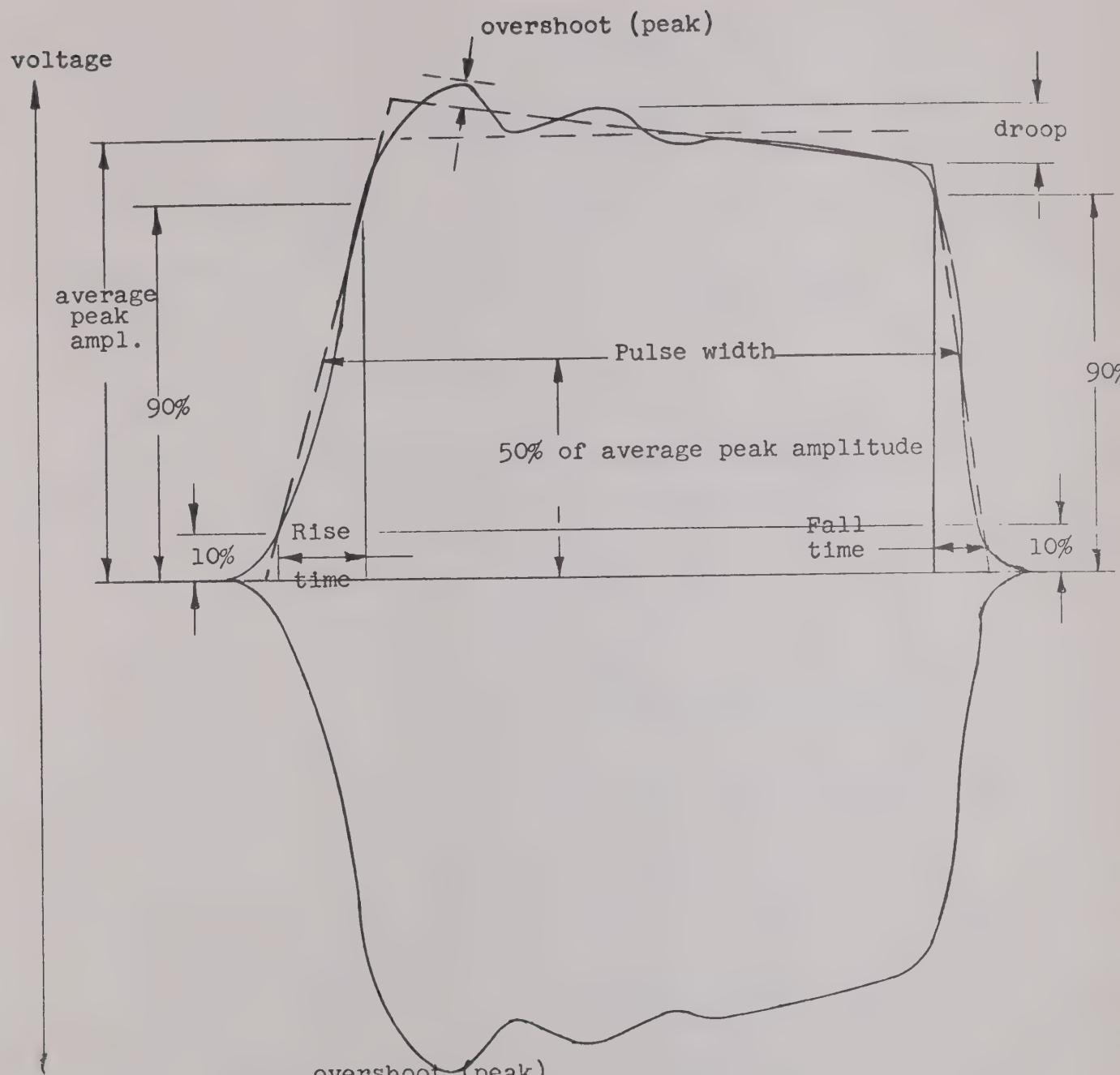


Figure 2-1. General appearance of RF pulse including video feedthrough signal.



$$\text{Overshoot (in \%)} = \frac{\text{overshoot (peak)}}{\text{average peak ampl.}} \times 100\%$$

$$\text{Droop (in \%)} = \frac{\text{droop}}{\text{average peak ampl.}} \times 100\%$$

Figure 2-2. General RF pulse excluding the video feedthrough signal.

h. Input Pulse Requirement:

Pulse Height:	< 5 V peak and < 100 V peak.
Maximum safe input power:	200 watts of available peak power at maximum duty cycle of 10%, from a pulse generator with a 50 Ω output impedance.
Maximum safe input voltage:	± 100 V peak.

i. PM Input Impedance: 440 Ω ±10%.

j. Peak Power Level Accuracy Peak Power of P.R.R., 500 Hz to 10 kHz: Add ±1.0 dB to CW power level accuracy specifications.

k. Frequency shift CW/Pulse: 1 MHz max.

2.2.5 FM Modulation Characteristics:

2.2.5.1 External Frequency Modulation:

Rear panel mounted BNC connector.

a. Modulation Frequency Ranges: For peak deviations 1 MHz - 10 MHz: DC-100 kHz.

b. Modulation Sensitivity: $\frac{2\text{MHz}}{\text{V}}$ nominally.

c. Maximum input voltage: ± 5 V peak.

d. Input Impedance: 5 KΩ nominally.

2.2.6 Marker Characteristics:

The Model 6600, Spec 2053 Mainframe/Model 6615ED, Spec 2055 sweep signal generator provides voltage derived markers M_1, M_2, and F_o.

a. Voltage Derived Markers M_1, M_2, F_o: These markers are derived from the main tuning voltage; they are produced in the Model 6600 Spec 2053 Mainframe. Their frequency accuracy is, therefore, equal to the CW frequency accuracy, which is ±20MHz at 25° C.

Sweep Mode	Available Markers
Full band sweep	M_1, M_2, F_o
$M_1 \rightarrow M_2$ sweep	F_o
$\triangle$ F sweep	M_1, M_2, F_o (fixed)

b. External (Video) Markers: M_1, M_2, F_o markers are available always as external markers on the front panel mounted "MARKER" BNC connector. The markers appear as triangular pulses. The amplitude of the triangular pulse can be varied with the front panel mounted "MARKER AMPL" control from 0 ("OFF" position) to -5 V peak. The width of the triangle increases linearly from 0 at 0 amplitude to about 10 MHz at maximum (-5 V) amplitude.

c. External Marker Output Impedance: 1 KΩ

d. Internal Markers: M_1, M_2, and F_o markers are available as triangular dip in RF power output when "MARKER" pushbutton on Model 6600, Spec 2053 Mainframe is depressed. The "MARKER AMPL" control controls the amplitudes of both the external and internal markers. The maximum dip in the RF power output is not specified, but is typically 10 dB. Marker accuracy for the internal markers is the same as for the external markers.

SECTION III

CONTROLS, INDICATORS AND RECEPTACLES

3.1 INTRODUCTION

This section contains functional descriptions of the controls, indicators and receptacles for the Model 6615ED Sweep Oscillator.

3.2 OPERATING CONTROLS, INDICATORS AND RECEPTACLES

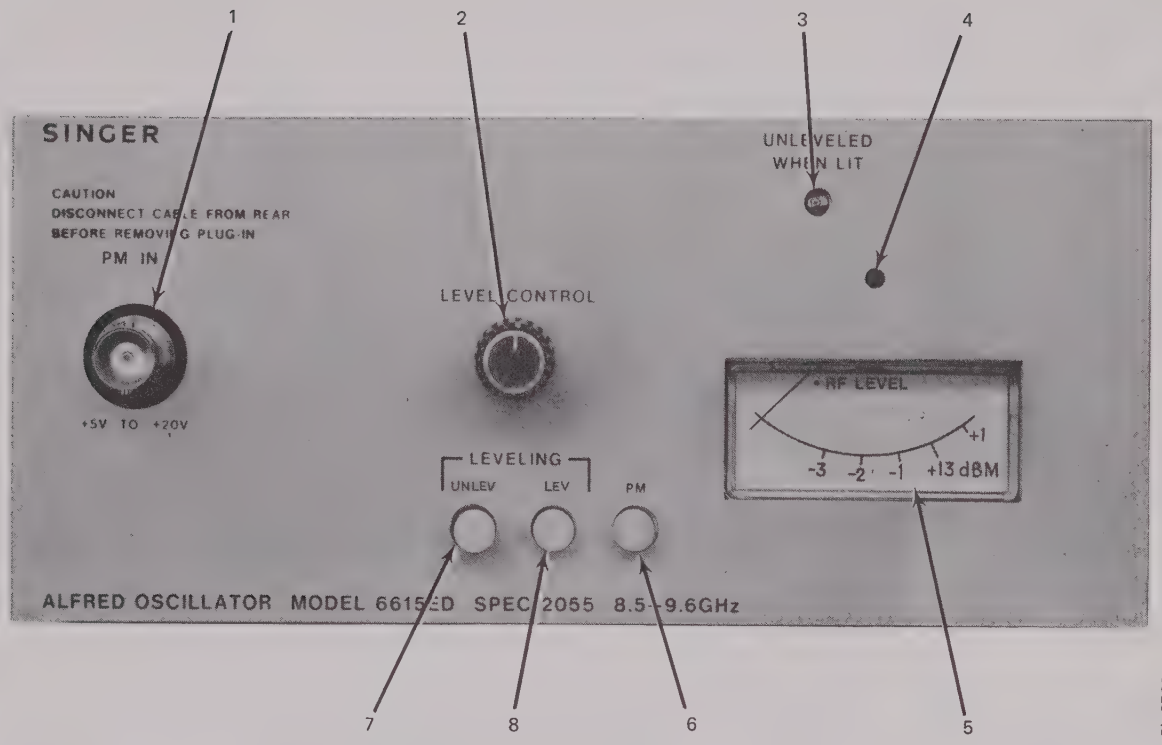
All external operating controls, indicators, and receptacles of the Model 6615ED, Spec 2055 Sweep Oscillator are located on the front and back panels as indicated by Figure 3-1. Functions are described in Table 3-1, items are located in Figure 3-1. Pin data information for multipin Plug P1 that provides the interconnection between the Model 6600 Mainframe and the Model 6615ED plug-in is provided in Table 3-2.

TABLE 3-1. CONTROLS, INDICATORS AND RECEPTACLES, MODEL 6615ED, Spec 2055

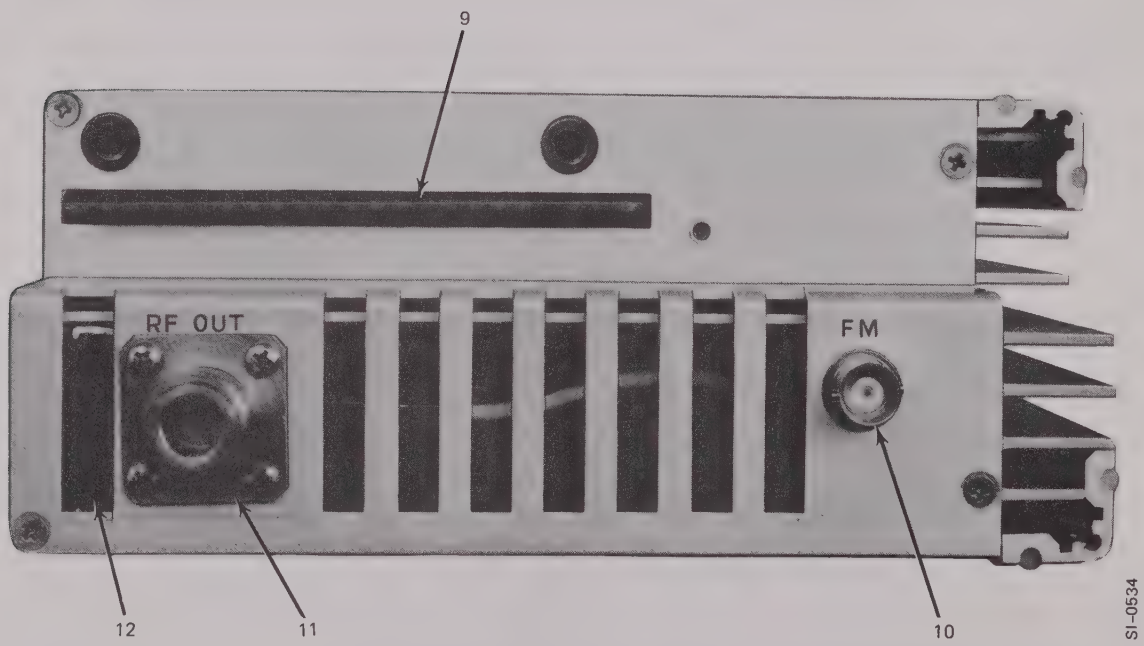
ITEM	PANEL MARKING	DESCRIPTION	FUNCTION
1	PM IN	BNC Receptacle (J1)	Pulse modulation input connector, 440Ω input impedance, Pulse input level > 5 V and < 100 V. Protected for 200 watts available peak power input at 10% duty cycle from 50Ω pulse generator.
2	LEVEL CONTROL	Potentiometer (R1-A/B)	RF level control, provides a range of at least 10 dB.
3	UNLEVELED WHEN LIT	LED Indicator	LED indicator lights when output signal is unleveled.
4	-	Slotted Control	Mechanical zero adjust for the Level Meter (M1).
5	RF LEVEL	Meter (M1)	Indicates RF output power (in pulse modulation RF peak power).
6	PM	Pushbutton Switch (A1A1A1 S1-C)	Pulse modulation selector pushbutton. With no pulse signal applied to the PM IN connector, the RF signal level is "off" (at least 60 dB below the output level with the PM pushbutton released).
7	LEVELING UNLEV	Pushbutton Switch (A1A1A1 S1-A)	Unleveled operation selector pushbutton.

TABLE 3-1. CONTROLS, INDICATORS AND RECEPTACLES, MODEL 6615ED, Spec. 2055 (Cont.)

ITEM	PANEL MARKING	DESCRIPTION	FUNCTION
8	LEVELING LEV	Pushbutton Switch (A1A1A1 S1-B)	Internal leveling selector pushbutton.
9	-	Plug, Circuit board (44 pins) (A4P1)	Plug, interconnect with Model 6600 Mainframe.
10	FM	BNC RECEPTACLE (J3)	FM input connector, BNC female, DC-1 MHz, 0-1 MHz peak deviation, DC-100 kHz, 0-10 MHz peak deviation.
11	RF OUT	Type "N" Receptacle (J2)	RF power output. 50 ohm impedance.
12	-	Slot	Frequency Dial Plate Slot.



FRONT VIEW



REAR VIEW

Figure 3-1. Operating Controls, Indicators, and Receptacles, Model 6615ED, Spec. 2055

TABLE 3-2. A4 ASSEMBLY PLUG PIN DATA (P1)

Pin	FUNCTION
1	F3 input: △ F or CW Fine tuning voltages
2	F1 input: F_1, M_1 or F_o(CW) tuning voltage. F_1 is start voltage for full band sweep, M_1 is start voltage for marker sweep.
3	Mainframe reference ground.
4	Mainframe reference ground (same ground as Pin 3).
5	Mainframe + 20 volts input.
6	Mainframe -20 volts input.
7	Mainframe + 10.5 volts input.
8	Mainframe ground.
9	Mainframe ground (same ground as Pin 8).
10	Not used by Model 6615ED, spec. 2055 (Model 6600 pin function- "diode res").
11	+ Prog. Res.
12	Not used by Model 6615ED, spec. 2055 (Model 6600 pin function - "+62V").
13	Not used by Model 6615ED, spec. 2055 (Model 6600 pin function - "-62V").
14	Not used by Model 6615ED, spec. 2055 (Model 6600 pin function - "-diode").
15	-Prog supply
16	+Prog supply
17	Not used by Model 6615ED, spec. 2055 (Model 6600 pin function - "band B").
18	Not used by Model 6615ED, spec. 2055 (Model 6600 pin function - "RBE").

TABLE 3-2. A4 ASSEMBLY PLUG PIN DATA (P1)

PIN	FUNCTION
19	Not used by Model 6615ED, spec. 2055 (Model 6600 pin function - "10db").
20	Not used by Model 6615ED, spec. 2055 (Model 6600 pin function - "40dB").
21	Mainframe RF marker.
22	Mainframe RF AM out.
23	Not used by Model 6615ED, spec. 2055 ("↓VPF"-Model 6600 pin Function).
24	F_2 input (F_2 or M_2 tuning voltages) F_2 stop voltage for full band sweep, M_2 stop voltage for marker sweep.
25	Mainframe reference ground (same ground as Pin 3)
26	Mainframe reference ground (same ground as Pin 3)
27	Mainframe + 20 volts input.
28	Mainframe - 20 volts input.
29	Mainframe - 10.5 volts input.
30	Mainframe ground (same ground as Pin 8)
31	Mainframe RF ground.
32	-Prog Res.
33	CW filter relay.
34	Not used by Model 6615Ed, spec. 2055 (Model 6600 pin function -"+62V").
35	Not used by Model 6615Ed, spec. 2055 (Model 6600 pin function -"-62V").
36	Not used by Model 6615ED, spec. 2055 (Model 6600 pin function -"-diode").

TABLE 3-2. A4 ASSEMBLY PLUG PIN DATA (P1) (Cont.)

PIN	FUNCTION
37	-Prog. supply
38	+Prog. supply
39	Not used by Model 6615Ed, spec. 2055 (Model 6600 pin Function - "band C").
40	Not used by Model 6615Ed, spec. 2055 (Model 6600 pin Function - "band A").
41	Not used by Model 6615 Ed, spec. 2055 (Model 6600 pin Function - "RAE").
42	Not used by Model 6615 Ed, spec. 2055 (Model 6600 pin Function - "20dB").
43	Not used by Model 6615 Ed, spec. 2055 (Model 6600 pin Function - "Ramp control").
44	RF Blanking

SECTION IV

INSTALLATION

4.1. INTRODUCTION

This section contains information on receiving inspection, 115V vs 230V operation, and installing the Model 6615ED Plug-in into the Model 6600 Mainframe.

4.2. RECEIVING INSPECTION

Upon receiving your Model 6615ED, Spec. 2055 and 6600 Spec. 2053, carefully unpack the instruments and check for shipment damage. If damage is evident, file a claim against the carrier. Check the unit for shipping damage. The front panel controls should move easily, with full travel. Pushbuttons should move in and out freely. Note any mechanical damage, and check the condition of the scale shipped with the unit. If there is any damage or deficiency, or if electrical performance is not within specifications, see the warranty inside the front cover of this manual.

4.3. PRELIMINARY INSPECTIONS

Preliminary inspection of the equipment is performed without operating power applied. This type of check is designed to detect conditions that might otherwise lead to a breakdown. Frequent causes of premature failure are overheating due to improper ventilation or loose connections and fittings. Inspection is carried out with emphasis on finding evidence of these conditions.

4.4. REMOVING AND INSTALLING THE 6615ED SPEC 2055/6600 SPEC 2053.

Mainframe and plug-in come completely assembled. The plug-in is powered from the mainframe. Therefore, only the mainframe has a

primary power cord. The Model 6600 is normally connected at the factory for operation at 115V AC nominal. Check the position of the slide switch under the plastic protective cover next to the power cord terminals to see that the switch is set to 115V. If the operation must be changed to 230V, remove the power cord, slide the plastic protective cover to the left to expose the fuse, remove the fuse and set the slide switch to the 230V position. Insert a new fuse. For fuse values use the numbers printed on the back panel of the Model 6600.

The Model 6615ED, Spec 2055 operates within its specifications only when used with a Model 6600 Spec. 2053 mainframe. The special 6600 affects the F_o fine scale accuracy and provides a 3rd marker (F_o marker) in the ΔF sweep mode. If a standard mainframe Model 6600 is used, the F_o fine scale readings have to be multiplied by 5/8, to provide an accurate F_o fine indication. Furthermore, the Model 6600 Spec. 2053 mainframe provides M_1, M_2 and F_o markers in the ΔF sweep mode, while the standard 6600 mainframe only provides M_1 and M_2 markers in the ΔF sweep mode.

The Model 6600 Mainframe comes without a frequency scale. The scale for the Model 6615ED, Spec. 2055 Plug-in is stored in a slot on the back panel of the plug-in. Pull the scale out and insert it into the Model 6600 as follows:

a. Place the beveled edge at the left end of the frequency scale under the lip at left end of the Model 6600 frequency dial. The corresponding lip at the right end of the Model 6600 frequency dial is spring loaded. Slide it about ¼ inch to the right, and place the frequency scale in position over the frequency dial. Two plastic pins are spring loaded to force the dial out for removal. Push them flush

with the dial, when mounting it.

b. Release the sliding lip and check that the frequency scale is secure. There is a calibration line on the frequency scale. This should coincide with two dots on the Model 6600 frequency dial. If it does not, adjust its position by turning the screwhead to the left center of the frequency scale.

Push the Model 6615ED plug-in into the Model 6600 front panel plug-in opening until the black lever is forced down, then up a little. Continue pushing the black lever up until almost flush. Several pounds force may be required to push the lever in. Turn the instrument on by pushing the power pushbutton. Make sure that the "PM" pushbutton on the 6615ED, Spec. 2055 and the "AM" pushbutton on the Model 6600 Mainframe are released. The power meter on the Model 6615ED, Spec. 2055 should give an indication. Adjust the Model 6615ED LEVEL ADJUST control to a convenient reading such as "+13 dBm" on the power meter scale. The instrument is ready for use within several minutes after turn on. However, some of the precise frequency accuracy specifications are only met after a one half hour warm-up period.

Set the front panel controls and pushbuttons on the Model 6615ED, Spec. 2055 to conform to the desired operation. Consult the description of front panel controls in Section III and the operating insrtuctions in Section V.

SECTION V

OPERATING INSTRUCTIONS

5.1. INTRODUCTION

Instructions for operating the Model 6615ED, Spec. 2055 Plug-in unit and the Model 6600, Spec. 2053 Mainframe are presented in this section. Refer to Section IV for installing the Plug-in into the Mainframe and for information on 115V versus 230V operation. Refer to Section III for a description of the operating controls, indicators, and receptacles.

5.2. OPERATING INSTRUCTIONS

5.2.1 CW Operation

For CW operation without markers set the front panel controls as follows. No signal applied to the Pulse Modulation Input on the 6615ED, Spec. 2055 front panel and to the FM Input on the back panel. "F_o" mode button depressed on Model 6600 Mainframe. "INT LEVELING" button depressed on the Model 6615ED, Spec. 2055 front panel.

5.2.2 Swept Frequency Operations

For any of the swept frequency operations (fullband sweep, $M_1 \rightarrow M_2$ sweep, and $\triangle$ F sweep around F_o) consult the Model 6600 instruction manual. However, the operation of the Model 6600 mainframe is very simple. When continuous swept frequency operation is required, make sure that either the internal or line trigger pushbutton is pushed in. Make sure the manual sweep control knob is pushed in and one of the sweep time pushbuttons is pushed in.

5.2.3 Meter Indication During Swept Operation

With no modulation signal applied either to the front panel mounted pulse modulation input connector on the Plug-in or external AM input on the Mainframe and with the AM button on the Mainframe not depressed, the Model 6615ED, Spec 2055 operates in the unmodulated mode. The meter indicates the power in dBm transmitted into a 50Ω load. In all modes of operation except the pulse modulation mode, the meter indicates the average detected voltage averaged over a time of about 0.1 second. If the blanking pushbutton is not depressed, the RF output during the flyback in swept operation is the same as the RF output during sweeping, and therefore the meter will indicate the power output as during the swept operation. If the blanking pushbutton is depressed, the power during the flyback time will be strongly attenuated, and therefore the meter indication will be affected in the following way:

0.01 second sweep speed range.

With the continuous sweep speed adjustment in the CAL position, the meter reading will be lower with the blanking pushbutton depressed than with the blanking pushbutton released. The decrease will be about 1.8 dB depending upon the detection law of the internal diode detector. The total "on" time is 10 msec sweep time plus 4 msec initial dwell time plus 4 msec final dwell time for a total "on" time of 18 msec. Retrace time is 4 msec. Therefore, the average reading will be 18/22 of the unblanked reading; if the detector operates in its linear range, the indicated decrease is 20 times the log of 22/18 or 1.8 dB nominally. If the detector operates in its square law range, the indicated decrease is 0.9 dB. If the continuous sweep time adjust control is set to the maximum sweep time, the decrease in meter reading with the

blanking pushbutton depressed will be less (about 1/2 of the decrease in the CAL position). The meter will flicker slightly.

0.1 second sweep range.

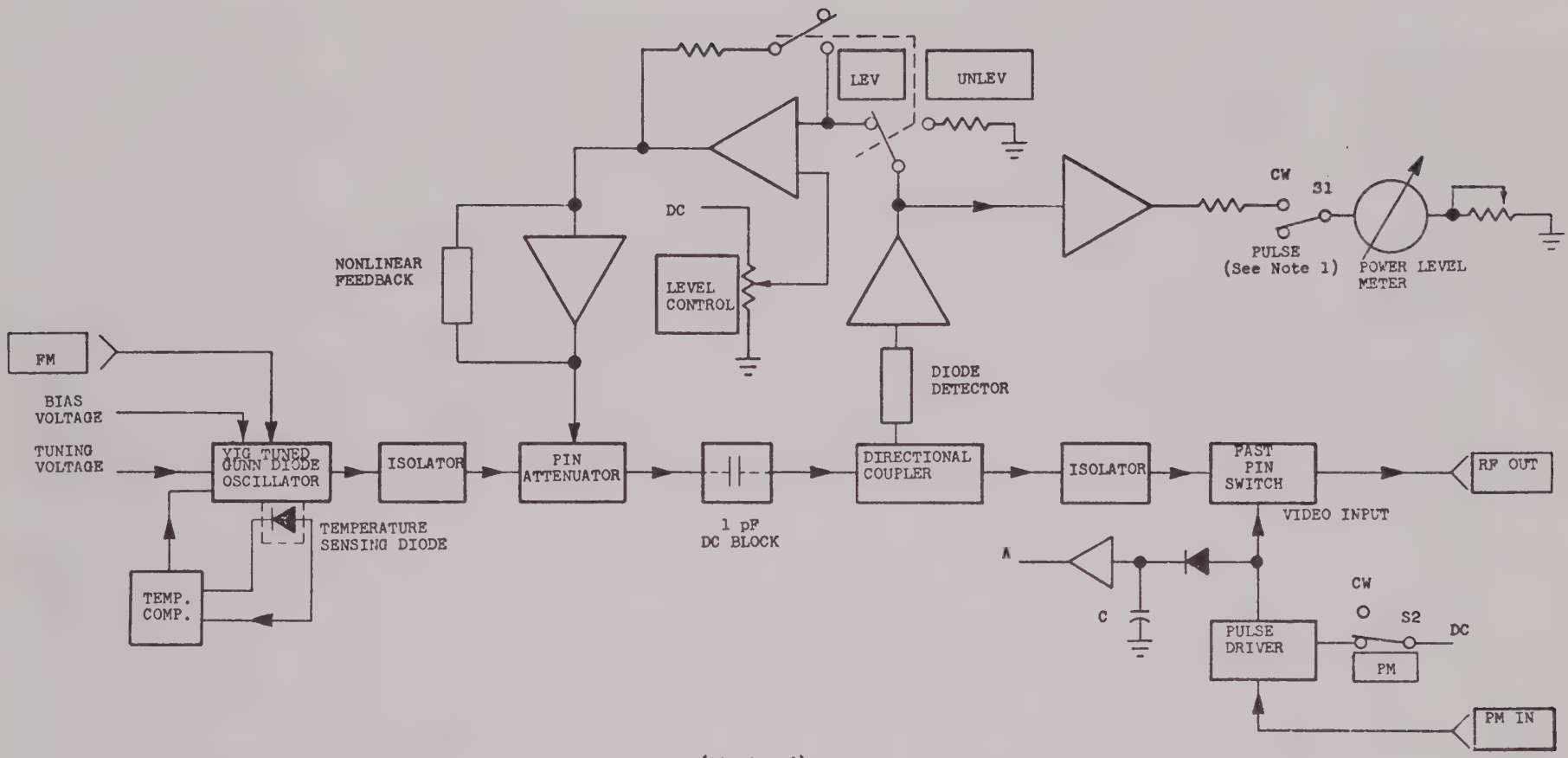
With the "0.1 sec" pushbutton depressed and the variable adjustment in the CAL position, the decrease in meter reading between unblanked and blanked operation is about 0.7 dB (total "on" time 108 ms, "off" time 10 ms; 20 times log of 118/108 equals about 0.7 dB). With the variable control at maximum, the sweep time is about 1 sec. Therefore, the meter will, during the sweep, indicate the proper output voltage and will show an instantaneous decrease during the retrace time (10 ms).

1 second and 10 second sweep speed ranges.

In the 1 second and 10 second sweep time ranges the meter reading during the sweep will be the same in retrace blanked or unblanked operation. There will be a decrease in meter reading during the retrace time when retrace is blanked. Since the retrace time in the 1 second sweep range is 100 ms, the meter indication will dip about 3 dB. In the 10 second sweep range where the retrace time is 1 sec, the meter reading will drop to zero for about a second and then come up again to the actual power output during sweep.

5.2.4 Setting the Power Level

The RF level meter scale contains a "+13 dBm" position. With the Mainframe set up in "F_o" or F_o fine" mode (fixed frequency mode) and the Plug-in operating in the LEVELING/LEV mode, the LEVEL CONTROL located at the Model 6615ED, Spec. 2055 front panel is adjusted until the meter indicates "+13 dBm". The output power into a 50Ω lead is now nominally 20 mW (+13 dBm). If F_o is set to 9.0 GHz, the output



NOTE 1: If point A is high, S2 will go to CW position (S1 closed).

Figure 5-1. Block Diagram of Model 6615ED, Spec 2055

power is 20 mW within ±0.5 dB at 25° 0. At any other frequency the actual output power might deviate ±1.0 dB due to the variation in the coupling factor and detection efficiency of the internal directional sampler with RF frequency ("flatness": specification is ± 0.5 dB referenced to 9.0GHz). The power level can be continuously varied over a range of at least 10 dB downward (nominally from +13 dBm to +3 dBm) by means of the LEVEL CONTROL knob. There is typically about 1 dB range available above +13 dBm within the leveled range. If the LEVEL CONTROL knob is turned clockwise beyond the leveled range, the red UNLEVELED WHEN LIT light comes on.

The meter is calibrated over a 4 dB range (-3 dB to + 1 dB with +13 dBm as 0 dB reference). Since the characteristics of the diode detector can vary slightly, no accuracies are given for the -3 dB, -2 dB, -1 dB and +1 dB markings.

5.2.5 Leveling Operation and Power Level Indication

The power level indication on the front panel meter is derived from a crystal detector which is connected to the side arm of a directional coupler located between the leveling PIN attenuator and the PIN switch used for pulse modulation (see Figure 5-1). The diode rectifies the RF and produces a dc voltage. At low levels this dc voltage is proportional to the RF power (square law range); at high levels the dc voltage is proportional to the RF voltage (linear range). This dc voltage is then compared to a reference dc voltage and the difference between the detected dc voltage and the referenced dc voltage is amplified and fed into the PIN attenuator which adjusts the RF level so that the dc voltage from the diode detector and the referenced voltage are essentially equal within the gain of the leveling loop. Once a level is set and the sweep generator is operated without modulation, the power level reading will not change regardless of

whether the sweep generator is swept broadband, or in $M_1 \rightarrow M_2$, or narrowband or operated in "F_o" or "F_o fine", except when the power is shut off during retrace, which was explained before. This operation is called leveled operation and any variation of the power output vs. frequency (called flatness) is caused by the change in detection efficiency of the diode detector or in the coupling factor of the directional coupler, and the variation of the insertion loss of the PIN switch with frequency. The directivity of the directional coupler produces an equivalent generator output impedance of 50 Ω.

The meter reading is calibrated in power level incident upon a 50Ω load connected to the back panel RF output of the Model 6615ED, Spec.2055 Plug-in.

When the Plug-in is pulse modulated the pulse signal is applied to the fast PIN switch. The pulse modulation is external to the leveling loop, see Figure 5-1. Since the RF "on" insertion loss of the fast PIN switch is kept the same as the CW insertion loss independent of the pulse input voltage, the power meter indicates the peak power of the pulsed RF output independent of pulse width and pulse repetition frequency. This arrangement, however, presents the problem that - with the PM button depressed and no proper pulse signal applied - the RF level meter still indicates power output, but in reality there is "no" power output ($>$ 60 dB lower than indicated). To avoid this problem, the RF level meter input contains an equivalent AND Gate: With the "PM" button depressed and no pulse signal at the fast PIN switch video input, the gate is open and the RF meter reading is zero. If pulse signal is applied to the "PM" input and its level raised until it reaches the triggering threshold of the final gate of the pulse driver, a pulse signal appears, the video peak detector charges capicitance C, point A in Figure 5-1 becomes high, the

gate closes, and the RF level meter indicates the peak level of the pulsed RF output.

Unleveled Operation

For unleveled operation the "UNLEV" pushbutton is depressed. This opens the leveling feedback loop, and lowers the gain of the comparison amplifier. The "LEVEL ADJUST" dc voltage is then applied through the fixed gain comparison amplifier to the PIN attenuator providing constant attenuation independent of the RF output level. This attenuation can be controlled by the "LEVEL ADJUST" knob.

5.2.6 Amplitude Modulation of Model 6600, Spec. 2053/6615ED, Spec. 2055

There are two possibilities of amplitude modulating the RF output:

A. Internal ON/OFF type square wave modulation at 1 kHz using the Model 6600 front panel mounted "AM" pushbutton.

B. External ON/OFF type square wave modulation feeding an external square wave into the Model 6600 rear panel mounted "AM" BNC connector.

A. Internal On/Off Type Square Wave Modulation Using the Model 6600 Front Panel Mounted AM Pushbutton

By pushing the AM pushbutton, the output signal of the Model 6615ED, Spec. 2055 will be square wave modulated between the CW level to which the instrument had been set just previous to pushing the button and "no" RF output power, which means that the output power is greatly attenuated (at maximum power level at least 40 dB).

The frequency of the 1kHz square wave modulation can be changed over a range of ± 50 Hz by using the "1 kHz adjust" control knob mounted on the rear panel of the Model 6600 Mainframe. This operation is helpful when making audio substitution type measurements such as VSWR measurements, insertion loss measurements, etc. using a crystal or bolometer square law detector, and audio instruments tuned to 1 kHz.

The leveling feedback loop adjusts the RF level during the "power on" period to the same level as was previously set during the CW operation. If the square wave is symmetrical (which means the period during which the power is on is equal to the period when the power is off), the RF level meter deflection will decrease to about 50% of the deflection for the unmodulated output.

If the Model 6600 front panel mounted "AM" pushbutton is pushed, and no AM occurs, check the "INT SQ WAVE" toggle switch on the Model 6600

rear panel. If it points towards the "OFF/ON PM IN" connector, it is set for external AM and the internal square wave type AM is disabled. Flipping the switch so that it points away from the BNC connector next to it, enables the internal AM and disables the external AM.

B. External On/Off Type Square Wave Amplitude Modulation

The Model 6615ED, Spec. 2055/6600, Spec 2053 RF Sweep Generator can also be square wave amplitude modulated in an ON/OFF fashion by connecting a square wave signal to the "OFF/ON PM" BNC connector on the rear panel of the Model 6600 and by placing the modulation switch from internal square wave to external square wave. In order for the external AM amplifier to be actuated, the dc resistance between the center conductor and the shell of the AM input connector should be 50Ω or less. Therefore, be sure the audio generator has a 50Ω output impedance. If this is not the case, a 50Ω shunt resistor should be connected at the AM input connector through a BNC tee. If an audio square wave generator is not available, a sinewave generator can be used with an amplitude of at least 7 volts peak. However, the rise and fall time will be slightly larger than with a square wave. The range of modulation frequency which can be covered is dc to 10 kHz since the external AM input circuitry is dc coupled.

Again, as with internal on/off square wave AM, the RF level during the "on" period is the same as the RF level which was set during CW operation. Therefore, the meter indication will again drop to about 50%. Due to the meter time constant, the meter indication will start fluctuating at low modulation frequencies, and at frequencies of about 1 Hz, the meter reading will go from the CW reading all the way to zero and up again at the same frequency as the modulation frequency.

The amplitude of the external square wave has to be at least +5 volts to turn the RF on and zero (or in the case of a symmetrical square wave -5 volts) to turn the RF off. When the external square wave amplitude modulation is not required, make sure to switch the rear panel mounted external/internal modulation switch back to internal. As stated before, if the front panel mounted AM button is pushed and no modulation is observed, check the position of the switch. It might have been left inadvertently in the external modulation position which makes the panel mounted AM button inoperative.

5.2.7 Pulse Modulation

Pulse Modulation is activated by depressing the "PM" pushbutton on the front panel of the Model 6615ED, Spec. 2055. To produce a pulse modulated RF signal a dc pulse has to be fed into the "PM" connector which has the desired pulse repetition rate and the desired pulse width. The pulse modulator inside the Model 6615ED, consists of a current limiting bridge and a series of gates and drive amplifiers which produce the proper voltage for the fast PIN switch so that during the "on" period of the pulse, the insertion loss of the PIN switch is the same as during the CW operation where the pulse input is replaced by a dc bias. Since the gates have a minimum triggering level, pulse operation will start abruptly when the input pulse voltage triggers the gates. This triggering level is set to be less than 5 volts. Therefore, the pulse input level should be at least 5 volts. The pulse RF output level is independent of the input pulse level. It is only controlled by the RF level adjust on the front panel of the Model 6615ED. The input circuit is designed so that the pulse input power from a 50Ω pulse generator can be as high as 200W peak as long as the available average power does not exceed 20 watts. Therefore, the maximum duty cycle with an available dc pulse input power of 200 watts is 10%. In order to achieve this safety feature the input impedance into the pulse modulation

input connector is made purposely high (440Ω). It is therefore recommended to make the cable connection between the pulse modulator and the pulse modulation input on the Model 6615ED short (<10 feet). However, the gate design in the pulse modulator makes the rise and fall time of the RF output pulse independent of the rise and fall times of the dc input pulse. The rise and fall time of the pulse at the RF pulse modulators is typically 10 nsec. The rise and fall time of the RF pulse is less than 50 nsec. The operation of the RF level meter during pulse modulation was described under "LEVELING OPERATION AND POWER LEVEL INDICATION, Internal Leveling". The meter indication will be valid for any pulse width of 0.2 sec, and for repetition frequencies of 500 pps. Since the pulse modulation circuit isDC coupled the pulse modulation frequency range extends down to DC; however, the meter reading at a pulse width of 0.2 sec and pulse repetition frequencies well below 500pps will be zero.

5.2.8 Use of Markers

The Model 6615ED, Spec. 2055/Model 6600, Spec 2053, RF Sweep Generator provides the following voltage derived markers: M_1, M_2, F_o.
The voltage derived markers are produced at certain tuning voltage levels of the main tuning voltage. They are produced in the Model 6600, Spec 2053 Mainframe. They are continuously adjustable over the entire frequency range by 3 front panel mounted knobs marked M_1, M_2, F_o. The same knobs, by the way, control in the $M_1 \rightarrow M_2$ sweep the start and stop frequencies of that sweep (M_1, M_2 markers) and the F_o marker adjustment produces also the CW frequency in the CW operation of the sweep generator. Refer to the Model 6600 Instruction Manual for a more detailed description. The markers are indicated on the main frequency dial with 3 points marked M_1, M_2, F_o.

Since these markers are derived from the main tuning voltage, their frequency accuracy is therefore equal to the CW frequency accuracy of ±20MHz. In the full band sweep all 3 markers are available. In the M_1, M_2 sweep only the F_o marker is available. In the ΔF sweep all 3 markers M_1, M_2, F_o are available. This is only the case in the Model 6600, Spec. 2053 Mainframe. In the regular Model 6600 Mainframe only the M_1 and M_2 markers are available in the ΔF sweep.

The markers are available always as external or video markers on the BNC front panel mounted "MARKER" BNC output connector on the mainframe. The markers are of triangular shape. The amplitude of the triangular pulse can be varied by means of the front panel mounted "MARKER AMPL" control from 0 ("OFF" position) to -5 volts peak. The frequency width of the triangle increases linearly from 0 at 0 amplitude to about 10 MHz at maximum amplitude (-5 volts). This triangular shape allows the operator to produce a readable marker at any sweep width, since the maximum marker width is about 1% of the total frequency range. In other words, if full band sweep is used, the marker amplitude is increased until the operator can see them readily. If the sweep width is very narrow like in the ΔF sweep, the marker amplitude is decreased until the marker width is narrow enough to allow a good resolution.

The external or video markers are used normally with a dual input oscilloscope where the detected RF is fed into input #1 and the marker output into the input #2. The sweep output is connected to the horizontal input of the scope. If the 3 dB or 6 dB or 60 dB bandwidth of an RF amplifier has to be checked, the detected RF is fed into #1 and the sweep width adjusted until the desired portion of the IF frequency response is displayed on the screen. The marker signal is added, which consists of a horizontal line displaying the marker as triangle pips. This horizontal line is then set

for instance, at 3 dB below (or 6 dB or 60 dB) the pass band level of the RF response, and the marker location varied until it coincides with the crossover between the horizontal line and the RF amplifier frequency response. The 3 dB (or 6 or 60 dB) frequencies can then be read directly off the main dial of the RF sweep signal generator.

5.2.9 Frequency Adjustment Procedure

When changing mainframes, it might be necessary to reset the frequency adjustment controls in the Model 6615ED, Spec. 2055 plug-in. The procedures are as follows: Insert the Model 6602A special into the Model 6600 Mainframe. Connect an RF cable to the rear panel RF output of the Model 6615ED, Spec. 2055 and feed the RF cable through the open extender box while inserting the Model 6615ED into the extender box. Remove the top cover of the Model 6615ED. Figure 5-2 shows the location of the adjustment potentiometers which are located on the PC board exposed when the top cover is removed. Connect a microwave frequency counter to the RF cable.Insert the frequency dial and adjust the location of the frequency dial with the screw on the left-hand side of the dial until the markings on the dial and the markings on the Model 6600 are aligned. Push the F_o button, make sure the output is not amplitude modulated. Set the F_o dial precisely on 8.50 GHz and adjust R20 until the counter reads 8.500 GHz. Move the F_o dial to precisely 9.60 GHz and adjust R18 until the counter reads 9.600 GHz. Repeat these two steps several times until the two frequencies readings are precisely on 8.500 and 9.600 $\pm$10 MHz. This is necessary due to the interaction of the two controls.

5.2.10 Temperature Compensation Control Adjustment After Exchange of Microwave Oscillator

If the oscillator has to be exchanged, the frequency temperature compensation control circuit has to be readjusted. The following is the temperature compensation control circuit adjustment. This has to be done before the frequency adjustment of the new oscillator is performed. Turn R32 fully counter clockwise, refer to Figure 5-2. Turn unit off for at least 30 minutes. Connect microwave counter to RF output. Turn the Model 6600 on and wait 30 minutes. Connect the ground lead of a digital DC voltmeter to ground and through the probe tip connect the hot lead of the digital voltmeter to PIN 6 of U4 as shown in Figure 5-2. Adjust R24 for 0.00V at U4, PIN 6. Set the F_o pointer precisely to 9.00 GHz on the dial and measure the RF frequency to at least 5 digits. Record this reading. Let the unit warm up an additional 30 minutes and without adjusting any other controls, adjust R32 until the counter reads the same frequency as recorded before.
After this temperature compensation adjustment, proceed with the frequency adjustment as described above.

Figure 5-2 shows controls and adjustments on the top side of the chassis, with the cover of the Model 6615ED, Spec. 2055, removed.

Figure 5-3 is a view of the bottom side of the same chassis, identifying RF components and the two back-panel connectors.

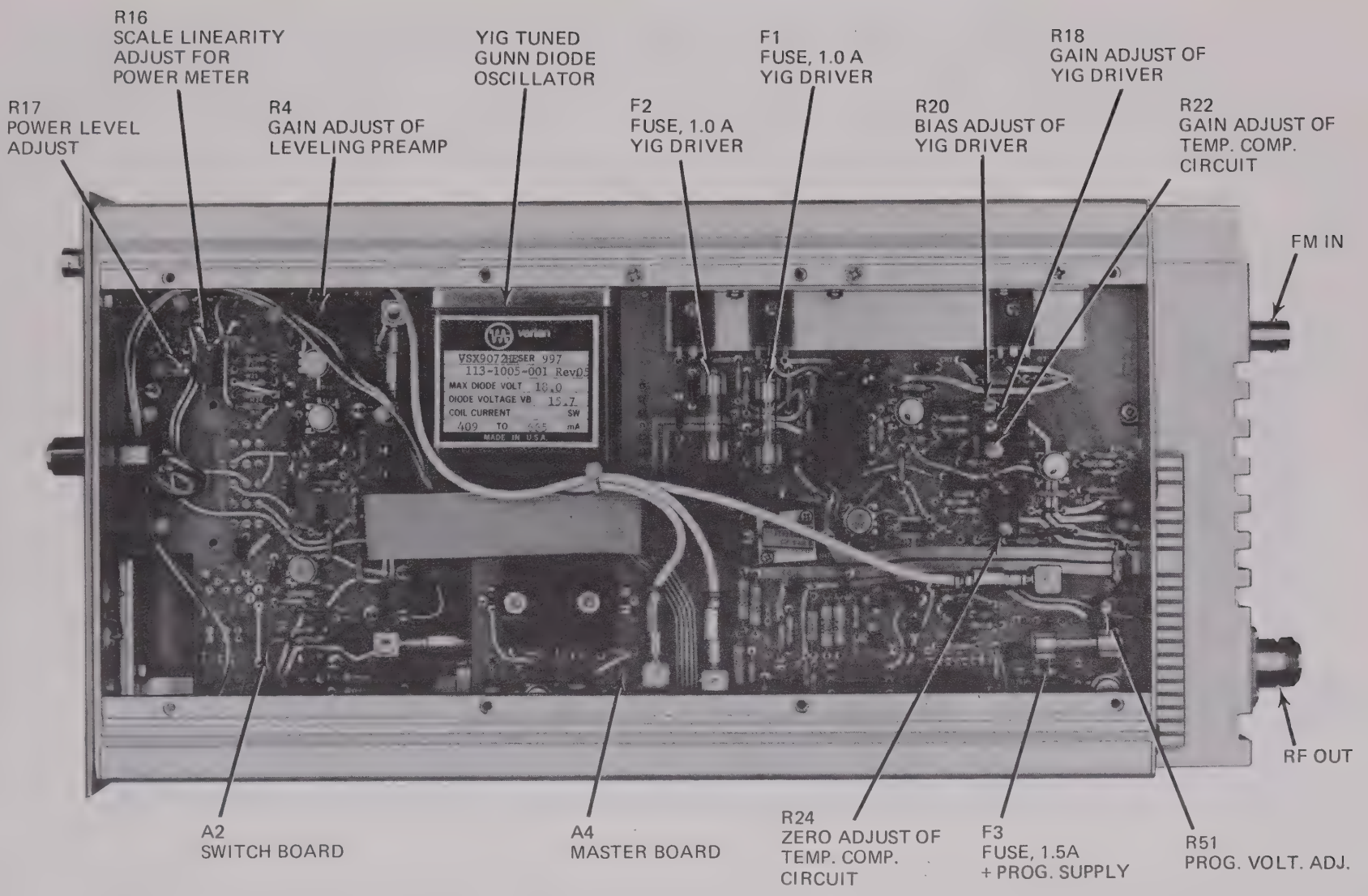


Figure 5-2. Top of Chassis Controls and Adjustments, Model 6615ED, Spec. 2055

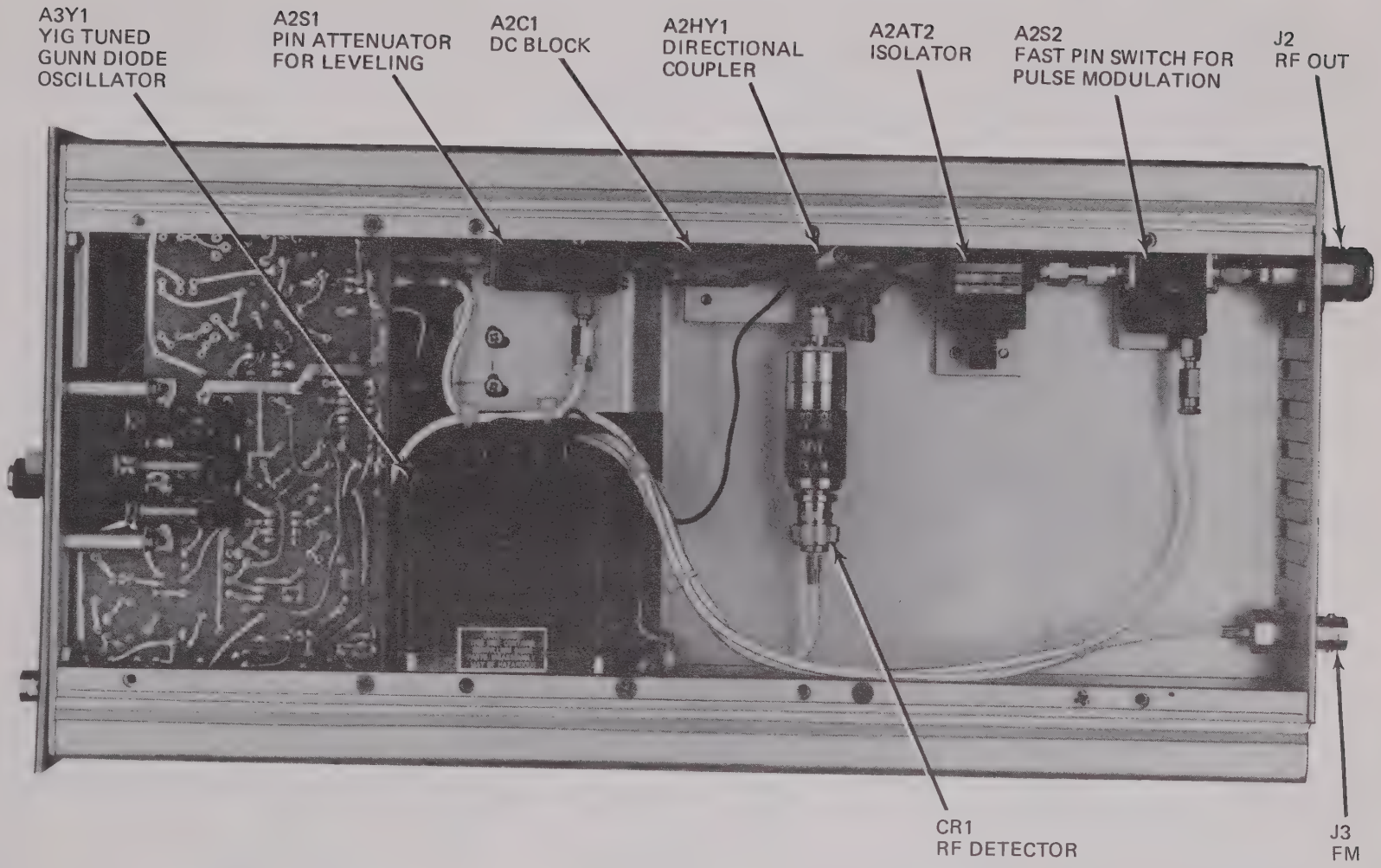


Figure 5-3. RF Components on Under Side of Chassis, Model 6615ED, Spec. 2055

Section VI

PARTS LIST

6.1 INTRODUCTION

This parts list section includes all pertinent data necessary to locate, identify, and procure additional parts for the equipment. Parts are listed alphanumerically by reference symbol and include all replaceable electronic items. In some cases, values, ratings and manufacturer sources shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement of the part(s) removed from the equipment.

6.2 ORDERING INFORMATION

The following instructions will aid in ordering parts from the parts list.

a. Address all inquiries or orders to:

CUSTOMER SERVICE
The Singer Company
5340 Alla Road
Los Angeles, California 90016

b. Include the following information:

(1) Model and Serial Number of instrument.

(2) Singer Part Number.

(3) Reference Symbol Number.

(4) Description (as shown on Parts List).

6.3 HOW TO USE THE PARTS LIST

Paragraphs 6.3.1 through 6.3.5 describe the use and meaning of the five columns included in the Parts List. Table 6-1 lists the assemblies covered by the Parts

List. Table 6-2 lists the manufacturer's code. Table 6-3 is a list of circuit reference symbols. Table 6-3 is a list of abbreviations used with this Parts List. Tables 6-5 through 6-13 list parts used in the Model 6606D, Specification 2054.

6.3.1 Reference Designation, Column 1

The Reference Designation column contains an alphanumeric listing of parts as they appear on the equipment chassis, illustration, or schematic. The reference designation identifies the parts as to their component function in the instrument.

6.3.2 Singer Part Number, Column 2

The Singer Part Number column contains the part number as designated by the Singer Company.

6.3.3 Description, Column 3

The Description column contains the identification of component parts, including all pertinent specifications. When the description column is used for a reference symbol for which no part exists, "Not used" is placed in the column. In these instances, columns 2, 4 and 5 are left blank.

6.3.4 Manufacturer's Code Number, Column 4

The Manufacturers Code Number column references the manufacturer by an assigned code number, as listed in Federal Supply Code Handbook H4-2. For manufacturers not listed in the Handbook, a letter code will be assigned. Table 6-2 includes the manufacturer and his code designation.

6.3.5 Manufacturer's Part Number, Column 5

The Manufacturer's Part Number shown contains the part number as designated by the manufacturer of the part.

TABLE 6-1. PARTS LIST BY ASSEMBLY NUMBER

TABLE	CIRCUIT REFERENCE	ASSEMBLY DESCRIPTION
6-5	-	Main Assemblies and Chassis
6-6	-	Miscellaneous Parts
6-7	-	Supplied Accessories
6-8	A1	Basic Assembly
6-9	A1A1	Inner Panel Assembly
6-10	A1A1A1	Switch Board Assembly
6-11	A2	RF Plate Assembly
6-12	A3	Heat Sink Assembly
6-13	A4	Master Board Assembly

TABLE 6-2. CODE LIST OF MANUFACTURERS

	Manufacturer	Address
IND-STD	Industry Standard. Order from any manufacturer.	
01121	Allen-Bradley Co.	Milwaukee, Wis.
03783	American Trading Co.	New York, N. Y.
04404	Hewlett-Packard Co.	Palo Alto, CA
04713	Motorola Semiconductor Products, Inc.	Phoenix, Ariz.
07263	Fairchild Camera and Instrument Corp.	Mt. View, CA
11312	Microwave Electronics Div. of Teledyn	Palo Alto, CA
11332	General Microwave	Farmingdale, N. Y.

TABLE 6-2. CODE LIST OF MANUFACTURERS (Cont.)

Code No.	Manufacturer	Address
13919	Burr-Brown Research Corp.	Tucson, Ariz.
14655	Cornell-Dublier Electric	Newark, N. J.
17856	Siliconix-Ledel	Santa Clara, CA
18324	Signetics Corp.	Sunnyvale, CA 94086
19701	Electra Mfg.	Independence, Kansas
21604	Buckeye Stamping Co.	Columbus, Ohio
31918	International Electronics Exchange	Eden Prairies, Minn.
31951	Triridge Corp.	Aliquippa, PA
32293	Intersil, Inc.	Cupertino, CA 95014
56289	Sprague Electric Co.	Springfield, Ill. 62705
67263	Hewlett-Packard	Palo Alto, CA
71590	American Lava Corp.	Chattanooga, Tenn.
71895	Delavan Mfg. Co.	West Des Moines, Iowa
72982	Erie Technological Products Inc.	Erie, PA
74970	E. F. Johnson Co.	Waseca Mn.
75042	IRC, Inc.	Philadelphia, PA
80294	Bourns Laboratory Inc.	Riverside, CA
88245	Litton Industries, Useco Division	Van Nuys, CA
88869	Singer Instrumentation	Los Angeles, CA
91506	Augat, Inc.	Attleboro, MA
91637	Dale Electronics, Inc.	Columbus, Nebraska
97574	ITT Export Corp.	New York, NY
98291	Sealectro Corp.	Mamaroneck, NY
99899	Narda Microwave Corp.	Plainview, LI, NY

TABLE 6-3. REFERENCE SYMBOLS

AR	Amplifier, IC	P	Plug, Connector
AT	Attenuator, Isolator	Q	Transistor
C	Capacitor	R	Resistor
CP	Adaptor	S	Switch
CR	Diode	T	Transformer
DS	Lamp	U	Integrated Circuit
J	Jack, Connector	Y	Oscillator
K	Relay	Z	Miscellaneous Parts: Ferrite Beads (RF Choke)
L	Coil		

TABLE 6-4. ABBREVIATIONS

Cer.	Ceramic	%	± % if sign not shown
Comp.	Composition	P/O	Part of
Dep. Car.	Deposited Carbon	Pot.	Potentiometer
Elec.	Electrolytic, Aluminum	pF	Picofarad
Fact. Sel.	Factory Selected	RF	Radio Frequency
IND-STD	Industry Standard	Spec.	Special
k	Thousand	Tant.	Tantalum Electrolytic
m	0.001 (1/1000)	Var.	Variable
M	Million	W	Watts
MF	Metal Film	WW	Wirewound
Mfr	Manufacturer	Ω	Ohms
No.	Number	pF	Microfarads
OTC	Zero Temperature Coefficient.		

TABLE 6-5. PARTS LIST FOR MAIN ASSEMBLIES AND CHASSIS

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
A1	101-0520-001	Basic assembly	88869	
A2	103-2436-001	RF plate assembly	88869	
A3	103-2435-001	Heat sink assembly	88869	
A4	103-2434-001	Master board assembly	88869	
W3	102-9522-003	Cable, coaxial, to A2S2, 18.5" long. Consisting of:	88869	
	179-3001-012	Coaxial cable	IND-STD	RG-188/U
	168-4031-001	Connector	98291	51-007-0000
	168-4080-001	Connector	98291	50-007-0000
W4	102-9522-004	Cable, coaxial, to A2S1, 5.25" long. Consisting of:	88869	
	179-3001-012	Coaxial cable	IND-STD	RG-188/U
	168-4031-001	Connector	98291	51-007-0000
	168-4080-001	Connector	98291	50-007-0000
W5	102-9522-005	Cable, coaxial, to A2HY1, 10.75" long. Consisting of:	88869	
	179-3001-012	Coaxial cable, semi-rigid 0.141" dia.	IND-STD	RG-188/U
	168-4031-001	Connectors	98291	51-007-0000
W6	102-9529-001	Cable, semi-rigid, coax. Consisting of: coaxial cable, semi-rigid, 0.141" dia.	88869	
	168-4108-001	Connectors		OSM 201-1A

TABLE 6-5. PARTS LIST FOR MAIN ASSEMBLIES AND CHASSIS (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
W7	952-272-02	Cable, ribbon A4 to A1A1A1, 5-3/4" long	88869	
W8	102-9524-001	Cable, ribbon, to A4P3 14" long. Consisting of:	88869	
	216-4	Flat cable	Spectra Strip	SS-2022-7B
	168-8053-001	Connector		
W9	102-9524-002	Cable, ribbon, to A4P2, 14" long. Consisting of:	88869	
		Hook-up wire, 20 GA		
	168-8053-001	Connector		

TABLE 6-6. PARTS LIST FOR MISCELLANEOUS PARTS

Quantity	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
1	170-5011-0512	Knob, level control	21604	RSS-50L- (L) 1/2 SCR

TABLE 6-7. PARTS LIST FOR SUPPLIED ACCESSORIES

Quantity	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
1	942-405-32	Frequency dial face plate	88869	
1	1-900783-310	Instruction Manual	88869	

TABLE 6-8. PARTS LIST FOR BASIC ASSEMBLY, A1

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
A1A1	103-2438-001	Inner panel assembly	88869	
CP1	168-4101-001	Adapter, Flange mount	Amphenal	901-268
W1	102-9522-001	Cable, coaxial, FM IN, 15.5" long. Consisting of:	88869	
	179-3001-012	Coaxial cable	IND-STD	RG-188/U
	168-1010-001	Connector, BNC, Bulk-head, Jack	91836	KC 19-152
J3	168-4031-001	Jack, panel	98291	51-007-0000

TABLES 6-9. PARTS LIST FOR INNER PANEL ASSEMBLY, A1A1

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
CR1	81-276	Diode, LED	29083	MV10B
M1	159-0016-002	Meter, 200μA, 75Ω	Dyna-metron	
R1A,B	912-185	Resistor, variable, dual, pot., 1 KΩ, ±10%, 0.5W		
W2	102-9522-002	Cable, coaxial, PM IN, 12" long. Consisting of:	88869	
	179-3001-012	Coaxial cable	IND-STD	RG-188/U
	168-1010-001	Connector	91836	KC19-152
J1	168-4031-001	Jack, panel	98291	51-007-0000

TABLE 6-10 PARTS LIST FOR SWITCH BOARD ASSEMBLY, A1A1A1

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
Ref.	127-0787-001	P.C. Board	88869	
		CAPACITORS		
		Note: Unless otherwise specified, all capacitors are fixed ceramic		
C1	12-21	27pF, ±5%, 1000V	72982	831-U2M-270K
C2	12-47	120 pF, ±10%, 1000V	72982	831-X5R-121K
C3	12-56	0.01 uF, ±20%, 25V	56289	C069B250 E1032
C4	12-56	0.01 uF, ±20%, 25V	56289	C069B250 E1032
C5	12-56	0.01 uF, ±20%, 25V	56289	C069B250 E1032
C6	12-41	10 pF, ±10%, 1000V	71590	DD-100
C7	12-27	270 pF, ±10%, 1000V	71590	DD-271
C8	13-91	33 uF, ±20%, 25V, Tqnt.	56289	196D336X 0025LA3
C9	12-56	0.01 uF, ±20%, 25V	56289	C069B250 E1032
C10	12-100	10 uF, ±20%, 35V	97574	TAG-10/ 35-20
C11	12-100	10 uF, ±20%, 35V	98574	TAG-10/ 35-20
C12	12-41	10 pF, ±10%, 1000V	71590	DD-100
		DIODES		
CR1	154-0013-001	G.P., 10 mA, 75V	IND-STD	IN4148
CR2	154-0013-001	G.P., 10 mA, 75V	IND-STD	IN4148
CR3	154-0013-001	G.P., 10 mA, 75V	IND-STD	IN4148

TABLE 6-10 PARTS LIST FOR SWITCH ASSEMBLY BOARD A1A1A1 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
		DIODES		
CR4	154-0013-001	G.P., 10 mA, 75V	IND-STD	IN4148
CR5	154-0013-001	G.P., 10 mA, 75V	IND-STD	IN4148
CR6	154-0013-001	G.P., 10 mA, 75V	IND-STD	IN4148
CR7	154-0013-001	G.P., 10 mA, 75V	IND-STD	IN4148
CR8	81-204	Zener, 10V, ±5%, 1W	04713	IN4740A
CR9	154-0013-001	G.P., 10mA, 75V	IND-STD	IN4148
		JACKS		
J1	133-128	16 pin socket	91506	516-AG1D
J2	168-3003-001	SMB, Rt. Angle	98291	51-053-0000
J3	168-3003-001	SMB, Rt. angle	98291	51-053-0000
		TRANSISTORS		
Q1	81-304	FET, 40V, 75 ma	17856	E112
Q2	556-146-988	PNP, 40V, 0.31W	IND-STD	2N3906
Q3	81-304	FET, 40V, 75 ma	17856	E112
Q4	556-146-989	NPN, 40V, 0.31W	IND-STD	2N3904
Q5	81-268	Dual, NPN, 45V	32293	IT122E
Q6	556-146-988	PNP, 40V, 0.31W	IND-STD	2N3906
Q7	556-146-989	NPN, 40V, 0.31W	IND-STD	2N3904
Q8	556-146-989	NPN, 40V, 0.31W	IND-STD	2N3904
Q9	556-146-988	PNP, 40V, 0.31W	IND-STD	2N3906
Q10	81-137	PNP, 60V, 0.3W	07263	2N3568
Q11	81-116	PNP, 15V, 0.2W	IND-STD	2N3646

TABLE 6-10 PARTS LIST FOR SWITCH BOARD ASSEMBLY, A1A1A1 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
		RESISTORS NOTE: Unless otherwise specified, all resistors are fixed ¼W, ±1% metal film.		
R1	59-10.2K	10.2 Kilohm	19701	RN55-D-1021F
R2	59-10.2K	10.2 Kilohm	19701	RN55-D-1021F
R3	59-9.31K	9.31 Kilohm	19701	RN55-D-9311F
R4	71-172	1.10K Ω, ±5%, 1W, variable	75042	205-208-1K
R5	59-5.11K	5.11 Kilohm	19701	RN55-D-5111F
R6	59-11.0K	11.0 Kilohm	19701	RN55-D-1102F
R7	59-1.33K	1.33 Kilohm	19701	RN55-D-1331F
R8	59-301K	301 Kilohm	19701	RN55-D-3013F
R9	59-10.0K	10.0 Kilohm	19701	RN55-D-1002F
R10	59-4.87K	4.87 Kilohm	19701	RN55-D-4871F
R11	59-5.11K	5.11 Kilohm	19701	RN55-D-5111F
R12	59-95.3K	95.3 Kilohm	19701	RN55-D-9532F
R13	59-19.6K	19.6 Kilohm	19701	RN55-D-1962F
R14	59-105K	105 Kilohm	19701	RN55-D-1053F
R15	59-18.7K	18.7 Kilohm	19701	RN55-D-1872F
R16	71-177	500, Ω variable	75042	205-208-500 Ω
R17	71-171	5.0kΩ, ±5%, 1W	75042	205-208-5K
R18	59-10.0K	10.0 Kilohm	19701	RN55-D-1002F
R19	59-750	750Ω	19701	RN55-D-7500F
R20	59-178	178Ω	19701	RN55-D-1780F

TABLE 6-10 PARTS LIST FOR SWITCH BOARD ASSEMBLY, A1A1A1 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R21	59-10.0K	10.0KΩ	19701	RN55-D-1002F
R22	59-10.0K	10.0KΩ	19701	RN55-D-1002F
R23	59-20.5K	20.5KΩ	19701	RN55-D-2052F
R24	59-5.11K	5.11KΩ	19701	RN55-D-5111F
R25	59-30.1K	30.1KΩ	19701	RN55-D-3012F
R26	59-3.83K	3.83KΩ	19701	RN55-D-3831F
R27	59-2.00K	2.00KΩ	19701	RN55-D-2001F
R28	59-511	511Ω	19701	RN55-D-5110F
R29	59-11.0K	11.0KΩ	19701	RN55-D-1102F
R30	59-11.0K	11.0KΩ	19701	RN55-D-1102F
R31	59-2.15K	2.15KΩ	19701	RN55-D-2151F
R32	59-5.11K	5.11KΩ	19701	RN55-D-5111F
R33	59-42.2K	42.2KΩ	19701	RN55-D-4222F
R34	59-11.0K	11.0KΩ	19701	RN55-D-1102F
R35	59-10.2K	10.2KΩ	19701	RN55-D-1022F
R36	59-2.37L	2.37KΩ	19701	RN55-D-2371F
R37	59-21.5K	21.5KΩ	19701	RN55-D-2152F
R38	59-97.6K	97.6KΩ	19701	RN55-D-9762F
R39	59-10.2K	10.2KΩ	19701	RN55-D-?022F
R40	59-20.0K	20.0KΩ	19701	RN55-D-2002F
R41	59-11.0K	11.0KΩ	19701	RN55-D-1102F
R42	59-5.11K	5.11KΩ	19701	RN55-D-5111F
R43	59-9.53K	9.53KΩ	19701	RN55-D-9531F
R44	59-12.1K	12.1KΩ	19701	RN55-D-1212F
R45	59-11.0K	11.0KΩ	19701	RN55-D-1102F

TABLES 6-10 PARTS LIST FOR SWITCH BOARD ASSEMBLY, A1A1A1 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R46	59-5.11K	5.11KΩ	19701	RN55-D-5111F
R47	59-11.5K	11.5KΩ	19701	RN55-D-1152F
R48	59-20.0K	20.0KΩ	19701	RN55-D-2002F
R49	59-1.05K	1.05KΩ	19701	RN55-D-1051F
R50	59-1.96K	1.96KΩ	19701	RN55-D-1961F
R51	59-2.37K	2.37KΩ	19701	RN55-D-2371F
R52	59-215	215Ω	19701	RN55-D-2150F
R53	59-2.37K	2.37KΩ	19701	RN55-D-2371F
R54	56-316	316Ω	19701	MF6C-D-3160F
R55	56-316	316Ω	19701	MF6C-D-3160F
R56	56-316	316Ω	19701	MF6C-D-3160F
R57	59-19.6K	19.6KΩ	19701	RN55-D-1962F
		SWITCHES		
S1	116-0051-001	Push button	31918	3XF125 (none) 2U STA IEE SR2 2GR
		INTEGRATED CIRCUITS		
U1	84-1	op. amp,	19324	LM101A
U2	84-1	op. amp,	18324	LM101A
U3	153-7057-001	op. amp,	27014	LM318
U4	153-7057-001	op. amp,	27014	LM318

TABLE 6-11. PARTS LIST FOR RF PLATE ASSEMBLY, A2

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
ATZ	252-24	Isolator, 8-12.4 GHz	11312	T8M-43A-1B
HY1	103-2437-001	Sampler Assembly, consisting of:	88869	
CD1	165-0006-001	Coupler	99899	4015C-20
CR1	950-920	Detector Assembly		
S1	252-18	Switch, pin diode	HP	HP33103A
S2	165-3003-001	Switch, pin diode	11332	M863H opt. 7
U1	103-2458-001	D.C. block	88869	

TABLE 6-12. PARTS LIST FOR HEAT SINK ASSEMBLY, A3

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
AT1	252-24	Isolator, 8-12.4 GHz	11312	T8M-43A-1B
CR1	154-0013-001	Diode, G.P., 10 mA, 75V	IND-STD	IN4148
Y1	113-1029-001	Oscillator		PEL OX-131

TABLE 6-13. PARTS LIST FOR MASTER BOARD ASSEMBLY, A4

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
Ref.	127-0783-001	P.C. Board	88869	
		CAPACITORS		
		Note: Unless otherwise specified, all capacitors are fixed ceramic.		
C1	12-41	10 pF, ±10%, 1 KV	71590	DD-100
C2	12-49	0.0018 µF	71590	AD-182
C3	150-2002-751 F60	750 pF, ±2%, 300 V	14655	CD15FC75/G03
C4	12-56	0.01 µF, ±20%, 25 V	56289	C069B250E1032
C5	12-56	0.01 µF, ±20%, 25 V	56289	C069B250E1032
C6	12-56	0.01 µF, ±20%, 25 V	56289	C069B250E1032
C7	12-47	120 pF, ±10%, 1000 V	72982	831-X5R-121K
C8	12-82	0.47 µF, ±20%, 100 V	88245	CY30A474M
C9	12-56	0.01 µF, ±20%, 25 V	56289	C069B250E1032
C10	12-56	0.01 µF, ±20%, 25 V	56289	C069B250E1032
C11	13-91	33 µF, ±20%, 25V, fixed tant.	56289	196D336X0025LA3
C12	12-82	0.47 µF, ±20%, 100 V	88245	CY30A474M
C13	12-22	100 pF, ±10%, 1000 V	72982	831-000-X5F0-101K
C14	12-100	10 µF, ±20%, 35V, fixed tant.	97574	TAG-10/35-20
C15	13-98	220 µF, ±20%, 10V, fixed tant.	56289	196P228X001TE4
C16	13-98	220 µF, ±20%, 10V, fixed tant.	56289	196P228X001TE4
C17	13-98	220 µF, ±20%, 10V, fixed tant.	56289	196P228X001TE4
C18	13-98	220 µF, ±20%, 10V, fixed tant.	56289	196P228X001TE4
C19	13-98	220 µF, ±20%, 10V, fixed tant.	56289	196P228X001TE4
C20	13-98	220 µF, ±20%, 10V, fixed tant.	56289	196P228X001TE4

TABLE 6-13, PARTS LIST FOR MASTER BOARD ASSEMBLY, A4 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
C21	12-82	0.47 uF ±20%, 100V	88245	CY30A474M
C22	12-56	0.01 uF ±20%, 25V	56289	C069B250E1032
C23	12-56	0.01 uF ±20%, 25V	56289	C069B250E1032
C24	12-56	0.01 uF ±20%, 25V	56289	C069B250E1032
C25	12-18	200 pF ± 10%, 600V	72982	831-000-X550-201K
C26	12-43	20 pF ± 10%, 1000V	71590	DD-200
C27	12-47	120 pF ±10%, 1000V	72982	831-X5R-121K
C28	12-56	0.01 uF ±20%, 25V	56289	C069B250E1032
C29	12-24	390 pF ±10%, 500V	72982	831-000-X5F0-391K
C30	12-72	0.1 uF ± 20%, 100V	72982	8131-100-W5R-104M
C31	12-21	27 pF ±5%, 1000V	72982	831-U2M-270K
C32	12-56	0.01 uF ±20%, 25V	56289	C069B250E1032
C33	13-91	33 uF ±20%, 25V	56289	196D336X0025LA3
C34	13-91	33 uF ±20%, 25V	56289	196D336X0025LA3
		DIODES		
CR1	154-0013-001	G.P., 10mA, 75V	IND-STD	IN4148
CR2	154-0013-001	G.P., 10 mA, 75V	IND-STD	IN4148
CR3	81-20	G.P., 1A, 600V	IND-STD	IN4005
CR4	81-20	G.P., 1A, 600V	IND-STD	IN4005
CR5	81-20	G.P., 1A, 600V	IND-STD	IN4005
CR6	154-0013-001	G.P., 10mA, 75V	IND-STD	IN4148
CR7	81-91	Zener IN4735A, 6.2V±5%, 1W	IND-STD	IN4735A
CR8	154-1012-001		04713	MR812
CR9	154-4004-001	hot carrier	67263	HP5082-2835
CR10	154-0013-001	G.P. 10 mA, 75V	IND-STD	IN4148

TABLE 6-13, PARTS LIST FOR MASTER BOARD ASSEMBLY, A4 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
CR11	154-0013-001	G.P. 10mA, 75V	IND-STD	IN4148
CR12	154-0013-001	G.P. 10 mA, 75V	IND-STD	IN4148
CR13	154-0013-001	G.P. 10 mA, 75V	IND-STD	IN4148
CR14	154-4004-001	hot carrier	67263	HP 5082-2835
		JACKS		
J1	133-128	16 pin socket, I.C.	91506	516-AG1D
J2	168-3003-001	Right Angle, SMB, Con Hex series	98291	51-053-0000
J3	168-3003-001	Right Angle, SMB, Con Hex series	98291	51-053-0000
J4	168-3003-001	Right Angle, SMB, Con Hex series	98291	51-053-0000
		RELAYS		
K1	158-0012-001	DPST, Reed, 24V	31951	220-200-24
		PLUGS		
P1	127-0783-001	Part of PC board	88869	
P2	168-3019-001	Waffer, 7 pin	27264	09-66-1071
P3	168-3019-001	Waffer, 7 pin	27264	09-66-1071
		TRANSISTORS		
Q1	153-5006-001	PNP, 100V, 24W	IND-STD	2N6180
Q2	153-5005-001	PNP, 100V, 10W	IND-STD	2N6178
Q3	556-146-988	PNP, 40V, 0.31W	IND-STD	2N3906
Q4	153-5005-001	PNP, 100V, 10W	IND-STD	2N6178
Q5	81-270	NPN, 10A, 70V	04713	MJE3055
Q6	81-277	PNP, 10A, 70V	04713	MJE2955
Q7	81-295	NPN, 80V, 70W	04713	MJE1102
Q8	81-116	PNP, 15VC, Max., 0.2W	IND-STD	2N3646

TABLE 6-13, PARTS LIST FOR MASTER BOARD ASSEMBLY, A4 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
Q9	81-116	PNP, 15VC, Max. 0.2W	IND-STD	2N3646
Q10	556-146-988	PNP, 40V, 0.31W	IND-STD	2N3906
Q11	556-146-988	PNP, 40V, 0.31W	IND-STD	2N3906
Q12	81-116	PNP, 15VC Max., 0.2W	IND-STD	2N3646
Q13	81-116	PNP, 15Vc Max., 0.2W	IND-STD	2N3646
Q14	81-116	PNP, 15VC Max., 0.2W	IND-STD	2N3646
		RESISTORS		
		Note: Unless otherwise specified, all resistors are fixed (1/4W, ±1% metal film)		
R1	59-10.0K	10.0K Ω	19701	RN55-D-1002F
R2	59-909	909Ω	19701	RN55-D-9090F
R3	59-178	178Ω	19701	RN55-D-1780F
R4	59-178	178Ω	19701	RN55-D-1780F
R5	59-383	383Ω	19701	RN55-D-3830F
R6	59-15.0K	15.0K Ω	19701	RN55-D-1502F
R7	44-4.7	4.7 Ω, ±5%, 1W	01121	GB4R75
R8	44-4.7	4.7 Ω, ±5%, 1W	01121	GB4R75
R9	59-1.00K	1.00K Ω	19701	RN55-D-1001F
R10	56-10.0	10.0Ω, ±1%, ½W	19701	MF6C-D-10R0F
R11	56-10.0	10.0Ω, ±1%, ½W	19701	MF6C-D-10R0F
R12	31-21.0K	21.0K Ω	19701	RN55-D-2102B
R13	31-21.0K	21.0K Ω	19701	RN55-D-2102B
R14	59-210K	210KΩ	19701	RN55-D-2103F
R15	31-21.0K	21.0K Ω	19701	RN55-D-2102B
R16	59-210K	210KΩ	19701	RN55-D-2103F

TABLE 6-13, PARTS LIST FOR MASTER BOARD ASSEMBLY, A4 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R17	31-21.0K	21.0KΩ	19701	RN55-D-2102B
R18	151-0068-001	50KΩ, ±10%, ½W, variable, WW	75042	205-208-50K
R19	59-576K	576KΩ	19701	RN55-D-5763B
R20	71-167	10KΩ,±5%, 1W, variable, WW	80294	3250W-1-103
R21	59-82.5K	82.5KΩ	19701	FM5C-D-8252F
R22	59-10.0K	10.0KΩ	19701	RN55-D-1002F
R23	59-909	909KΩ	19701	RN55-D-9090F
R24	71-170	200Ω, ±5%, 1W, variable, WW	80294	3250W-1-201
R25	59-909	909Ω	19701	RN55-D-9090F
R26	59-1.37K	1.37KΩ	19701	RN55-D-1371F
R27	59-10.0K	10.0KΩ	19701	RN55-D-1002F
R28	59-1.40K	1.40KΩ	19701	RN55-D-1401F
R29	59-44.2K	44.2KΩ	19701	RN55-D-4422F
R30	59-51.1K	51.1KΩ	19701	RN55-D-5112F
R31	59-750K	750KΩ	19701	RN55-D-7503F
R32	71-176	2.0KΩ, ±5%, 1W, variable, MF	75042	205-208-2K
R33	59-133K	133KΩ	19701	RN55-D-1333F
R34	59-133K	133KΩ	19701	RN55-D-1333F
R35	59-56.2K	56.2KΩ	19701	RN55-D-5622F
R36	59-8.25K	8.25KΩ	19701	RN55-D-8251F
R37	59-249K	249KΩ	19701	RN55-D-2493F
R38	59-30.1K	30.1KΩ	19701	RN55-D-3012F
R39	59-1.00K	1.00KΩ	19701	RN55-D-1001F
R40	59-68.1	68.1Ω	19701	RN55-D-68R1F
R41	59-8.25K	8.25KΩ	19701	RN55-D-8251F

TABLE 6-13, PARTS LIST FOR MASTER BOARD ASSEMBLY, A4 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R42	59-1.00K	1.00KΩ	19701	RN55-D-1001F
R43	59-2.21K	2.21KΩ	19701	RN55-D-2211F
R44	59-1.00K	1.00KΩ	19701	RN55-D-1001F
R45	59-1.00K	1.00KΩ	19701	RN55-D-1001F
R46	59-10.0K	10.0KΩ	19701	RN55-D-1002F
R47	61-46	2.0Ω, ±3%, 5W, WW	91637	RH-5-2.0Ω
R48	59-20.0	20.0Ω	19701	RN55-D-20R0F
R49	59-1.50K	1.50KΩ	19701	RN55-D-1502F
R50	59-715	715Ω	19701	RN55-D-7150F
R51	71-177	500Ω, ±5%, 1W, variable, WW	80294	3250W-1-501
R52	56-2.05K	2.05KΩ	19701	MF6C-D-2051F
R53	56-2.05K	2.05KΩ	19701	MF6C-D-2051F
R54	59-2.05K	2.05KΩ	19701	MF6C-D-2051F
R55	59-1.78K	1.78KΩ	19701	RN55-D-1781F
R56	59-3.48K	3.48KΩ	19701	RN55-D-3481F
R57	59-1.00K	1.00KΩ	19701	RN55-D-1001F
R58	59-3.48K	3.48KΩ	19701	RN55-D-3481F
R59	59-523	523Ω	19701	RN55-D-5230F
R60	59-1.33K	1.33KΩ	19701	RN55-D-1331F
R61	59-464	464Ω	19701	RN55-D-4640F
R62	59-4.64K	4.64KΩ	19701	RN55-D-4641F
R63	59-698	698Ω	19701	RN55-D-6980F
R64	59-3.48K	3.48KΩ	19701	RN55-D-3481F
R65	59-249	249Ω	19701	RN55-D-2490F
R66	59-3.01K	3.01KΩ	19701	RN55-D-3011F

TABLE 6-13, PARTS LIST FOR MASTER BOARD ASSEMBLY, A4 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
R67	59-3.01K	3.01Kn	19701	RN55-D-3011F
R68	56-249	249n, ½W	19709	MF6C-D-2490F
R69	56-249	249n, ½W	19709	MF6C-D-2490F
R70	56-249	249n, ½W	19709	MF6C-D-2490F
R71	56-1.21K	1.21Kn, ½W	19709	MF6C-D-1211F
R72	56-10.0	10.0n, ½W	19709	MF6C-D-10R0F
R73	56-10.0	10.0n, ½W	19709	MF6C-D-10R0F
R74	56-10.0	10.0n, ½W	19709	MF6C-D-10R0F
R75	151-1003-475J	4.70 Megohms, ±5% comp.	01121	CB4755
R76	59-2.15K	2.15Kn	19701	RN55-D-2151F
R77	59-17.8K	17.8Kn	19701	RN55-D-1782F
R78	151-1003-475J	4.70 Megohms, ±5%, comp.	01121	CB4755
R79	59-4.64K	4.64Kn	19701	RN55-D-4641F
R80	59-4.64K	4.64Kn	19701	RN55-D-4641F
R81	59-4.64K	4.64Kn	19701	RN55-D-4641F
R82	59-8.45K	8.45Kn	19701	RN55-D-8451F
R83	59-9.31K	9.31Kn	19701	RN55-D-9311F
		INTEGRATED CIRCUITS		
U1	84-1	Op. amp.	18324	LM101A
U2	153-7056-001	Op. amp.	13919	TP1319
U3	153-7056-001	Op, amp.	13919	TP1319
U4	84-1	Op. amp.	18324	LM101A
U5	84-1	Op. amp.	18324	LM101A
U6	153-7037-001	Triple 3 input N and gates	18324	S5410A
U7	153-7041-001	Quad Z input nor gate	18324	S5402A

TABLE 6-13, PARTS LIST FOR MASTER BOARD ASSEMBLY, A4 (CONT.)

Ref. Desig.	Singer Part No.	Description	Mfr. Code No.	Mfr. Part No.
		MISCELLANEOUS		
TP1	168-6001-01R	Test point, jack, red nylon	74970	105-852
TP2	168-6001-01R	Test point, jack, red nylon	74970	105-852
TP3	168-6001-01R	Test point, jack, red nylon	74970	105-852

SECTION VII

SCHEMATIC DIAGRAMS

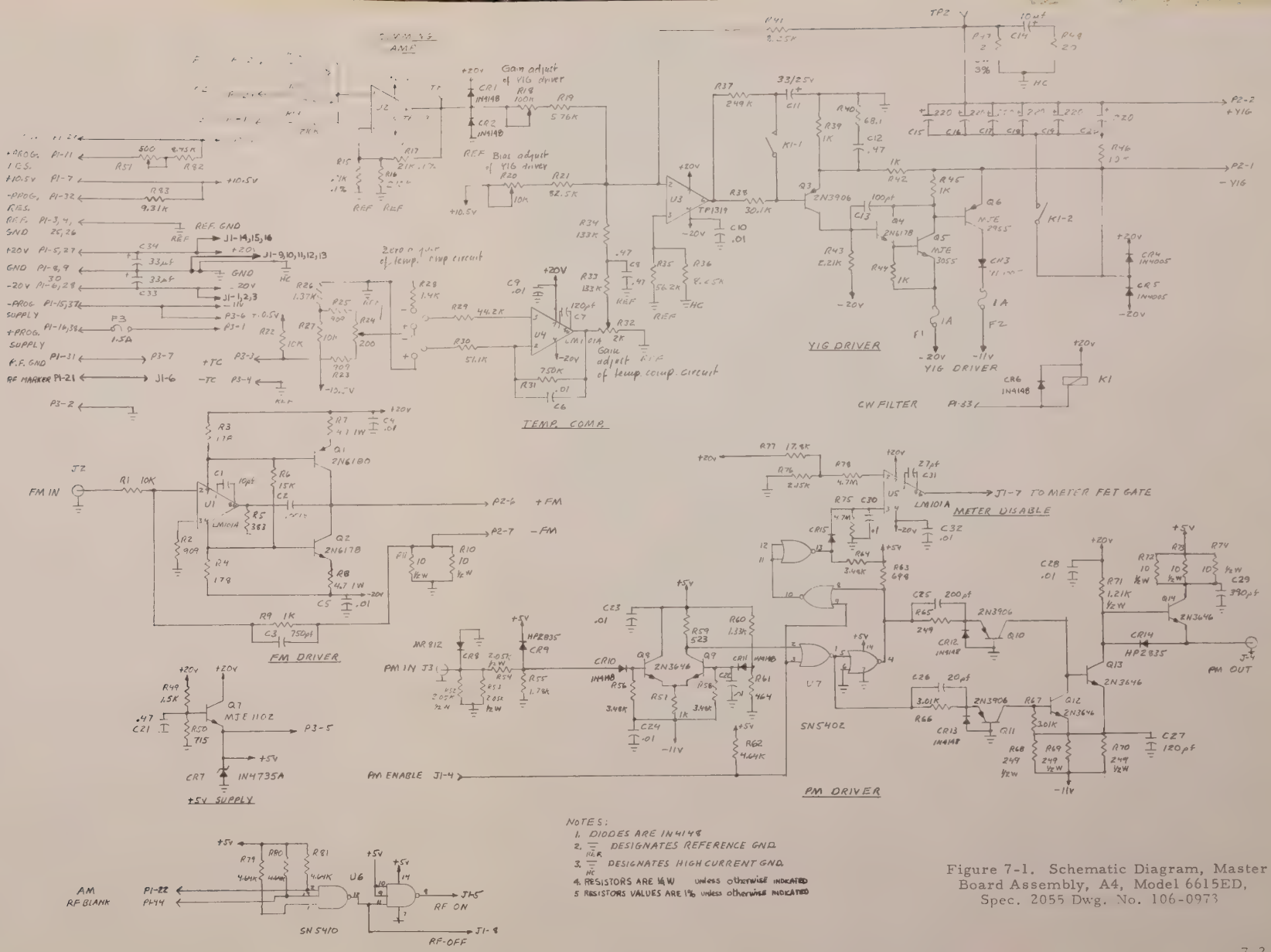
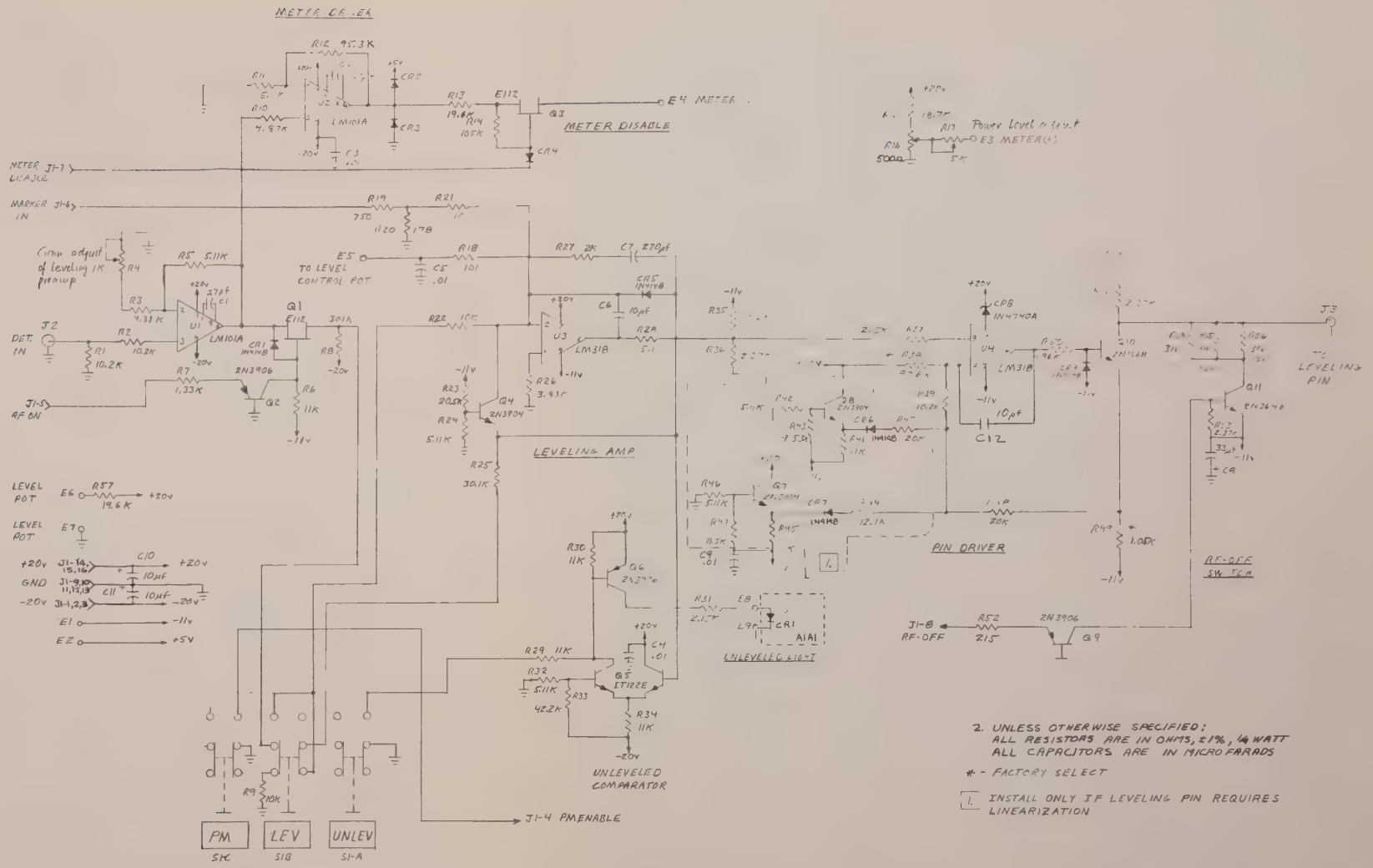


Figure 7-1. Schematic Diagram, Master Board Assembly, A4, Model 6615ED, Spec. 2055 Dwg. No. 106-0973



2. UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, ±1%, ¼ WATT
ALL CAPACITORS ARE IN MICROFARADS

* - FACTORY SELECT

1. INSTALL ONLY IF LEVELING PIN REQUIRES LINEARIZATION

2. ALL CAPACITORS ARE IN MICROFARADS.
1. ALL RESISTORS ARE IN OHMS, ±1%, 1/4 W.

NOTES: UNLESS OTHERWISE SPECIFIED -

Figure 7-2. Schematic Diagram, Switch Board Assembly, A1, Model 6615ED, Spec. 2055 Dwg. No. 106-0974

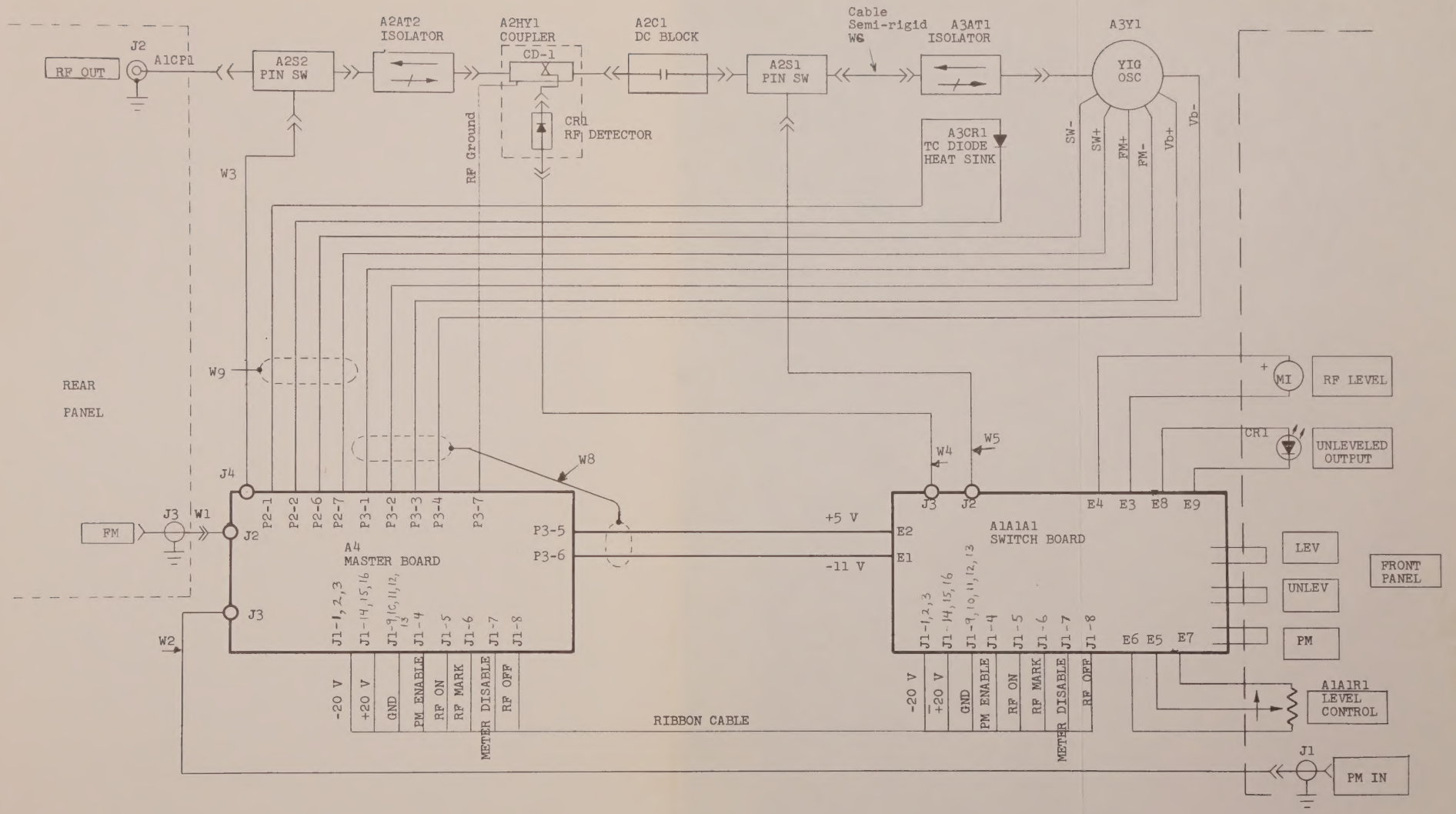


Figure 7-3. Wiring Diagram, Model 6615ED, Spec. 2055

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